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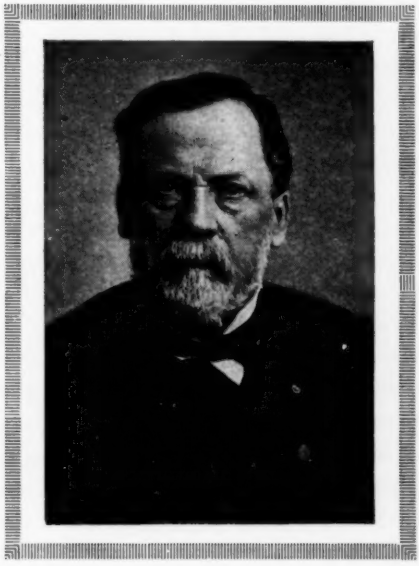
VOL. 94. DECEMBER, 1922. NO. 12.

EDITORIAL

PASTEUR THE PIONEER.

Less than half a century ago the aristocracy of medicine foregathered at the Academie de Medicine in Paris to participate in a symposium on puerperal fever. An eloquent fellow of the Academy held the rostrum and delivered a long discourse on the causative factors of this baneful fever, long the grim and merciless ravager of the lying-in hospitals of that city. Empiric and inaccurate were the theories which he expounded, but such indeed was the character of most of the etiologic knowledge of that period.



The speaker, whose name History does not and need not record, after ridiculing those who believed in the germ theories of disease, draws his lecture to a close. Promptly from his seat, which he held as an Associate of the Academy, there arose the genius Pasteur, whose marvellous discoveries in the world of science kept the eyes of the civilized world riveted on France; Pasteur, the son of an humble tanner from Arbois, lifted by the buoyancy of clear genius into that rare realm of pure science, whose boundless domains few humans are

privileged to know; Pasteur, the living contradiction of Pope's famous couplet,

"One Science only with one genius fit,
So vast is Art, so narrow human wit."

But not so with Pasteur, for his inspiration led him on from science to science, explaining the old and establishing the new; harnessing chemistry to agriculture and biology to industry. And he was a pioneer, a blazer of new trails. The roads which he chose were the hardest, but they led always to kingdoms that had the things which men sought and longed for, but could not find for themselves.

It was this Pasteur who arose in that august assembly of doctors and surgeons, and who had the temerity to say that the eloquent gentleman erred in stating that puerperal fever was not due to a microbe. In a hotbed of conventionalities and false dogmas, in an Academy proud of its conservatism, Pasteur, not even a physician, thus contradicted with bluntness but with correctness, the foremost practitioners of the day.

To clinch his statements he went to the blackboard and drew on it the rosary of streptococci, which he described as minute round organisms, growing in chains and which he had discovered in the blood clots during infection following childbirth. "There," said Pasteur, "you have its outlines." (*"Tenez, voici sa figure."*) And with the very sound of the words, as it were, came the dawn of a new day. The art of medicine and the science of surgery became possessed of a firmer sense of service and a new responsibility. Out of the world went a heap of sadness, and man's burdens eased upon his weary shoulders. Thus it was that the tanner's boy from Arbois, in France, came to change the whole aspect of medicine and surgery.

Out of the di-symmetry of life France produced in the same age two remarkable men, one the crystal genius, Pasteur, whose beautiful life and works stand unparalleled in the annals of science, saviour of millions of lives; the other, the genius Napoleon, who likewise stands unparalleled but only as a destroyer, and who sent legions of men to an early death. Pasteur whose works will carry on to the end—Napoleon whose influence has long since gone into the darkness.

Today, in the Pasteur Institute, close to the heart of Paris, lies the body of the great benefactor of posterity. It is well that France has remembered. For a world remembers him today, the centenary of his birth, and in Paris—his city—in the vault over his grave, are four great white angels, Faith, Hope, Love and Science, watching silently over their sleeping son.

I. G.

A NEW PERIL FOR PHARMACISTS.

A recent conviction of a pharmacist after a trial by jury in a Pennsylvania Common Pleas Court for violation of the State liquor law brings a new peril into view for pharmacists.

Contrary to the first picture which flashes into the mind of a "bootlegging druggist" taking a chance in connection with the sale of "hootch" without a prescription, this is a case of a conscientious pharmacist who has not even handled potable spirits on prescription, who conducts a professional store with no soda fountain, candy counter or similar side lines and who was penalized for selling a well-known proprietary brand of "bathing alcohol" to several individuals, who used the liquid internally with intoxicating effects.

The defendant admitted the sales in question, but declared that at the time the sales were made he had not known or suspected that it was purchased with the intent to use it as a beverage and as soon as he learned of its possible use in this connection he had stopped its sale and cancelled his orders for future supplies.

The judge in his charge to the jury, after quoting the high percentage of alcohol in the preparation said:

"With that volume of alcohol these goods would be intoxicating, and as we apprehend the law the only question in this case for you to determine is whether this defendant sold to these witnesses the goods testified to by them for beverage purposes. Whether this mixture was or was not ordinarily and in general acceptance fit for use as a beverage, we do not regard as material."

The fine imposed in the case after the jury had returned a verdict of guilty was $750, a very large amount.

Under conditions as above described no pharmacist is safe in selling even a bottle of flavoring extract or perfume unless he obtains an

affidavit from the purchaser setting forth the legitimate purpose for which the article is to be used.

Another and more important phase of the situation is the apparent inadequacy of the denaturing or medication or whatever they choose to call the addition of foreign substances that is required for the numerous alcoholic preparations sold for external use under special Federal permit.

Some of these preparations are unsuited for internal administration, while others either are not or can easily be made potable by a little manipulation. It is evident that the community is full of dipsomaniacs and worse who will drink anything that has a "kick" in it. The ghastly tale of pre-Volstead days of the janitor at a well-known natural history museum who had to be discharged because he drank the alcohol which he removed from the reptile specimens has lately been surpassed by an incident in a Philadelphia hospital where an orderly was detected removing and using for beverage purposes the alcohol in which the cancer specimens had been preserved. Another authentic case is one in which a popular brand of "solidified alcohol" figures. This is said to be prepared for "internal administration" by squeezing it through cheesecloth, which removes the major portion of the sodium stearate and yields a very impure form of denatured alcohol which seems to be tolerated by those who have formed a liking for it. Still another instance is one in which a painter, who had been making repeated purchases of commercial denatured alcohol, and who to prove his legitimate need for it brought in a bottle containing linseed oil with which the alcohol was mixed to ostensibly produce a furniture polish or paint cleaner. He was later detected in the act of drinking several ounces of this unsavory mixture.

Are we developing drinkers who are immune to substances ordinarily considered toxic? Must an alcoholic preparation actually contain poison in order to make its sale for technical or external purposes legal, and in that manner eliminate the foolhardy ones who take a chance, who will make their exit via the River Styx and leave the United States populated with only the law-abiding and careful?

And what of the grocery stores and department stores which have counters filled with these specially denatured alcohols for external use? Bathing in alcohol would seem to be more popular than bathing in water from the volume of business carried on and the way the producers advertise and fight for it.

The whole system of Federal regulations is weakened by such a condition and all of the elaborate rules for ensuring non-potability are thrown into disrepute.

Pharmacists are harassed and beset by enough troubles connected with the use of alcohol in official preparations without rendering it perilous to make occasional retail sales of preparations which have been approved by Federal authorities as non-potable. Truly these are parlous times when one who walks even a straight and narrow path is likely to stumble in the darkness brought about by official incapacity.

C. H. L.

(In connection with the foregoing editorial, the following caustic article from the columns of the Scrantonian, a lay newspaper, furnishes the sympathetic viewpoint of a person outside the ranks of pharmacy. "While the bottlegger, home-brew artist and others may secure the stuff with which to endanger the lives of those inclined to indulge in intoxicants, the honest druggist, who tries to live up to the law, is constantly pestered by arbitrary rulings of revenue officials puffed with brief authority. The rulings of these addle-pated fanatics, coupled with the activity of the sleuths who are apparently anxious to 'get something' on the pharmacist have made the lives of druggists miserable.

"The government sleuths and pin-head commissioners who give 'rulings,' act apparently on the supposition that every drug store in the land is a speak-easy and that no one wants alcohol for any save drinking purposes. Thus while the men who run liquors through the country at night and at other times do not appear to worry these revenue officials very much, the sleuths believe that the druggists should be watched.")

Editor.

ORIGINAL ARTICLES

LOUIS PASTEUR.

By Louis Gershenfeld, Ph. M., B. Sc., P. D.

(Professor of Bacteriology and Hygiene, Philadelphia College of Pharmacy and Science.)

Louis Pasteur is the most striking figure in nineteenth century science. By the force of his intellectual energy he lifted himself to the level of earth's great men. He revolutionized chemistry, physics, biology, medicine and surgery. He opened up the new fields of bacteriology, embalming and sanitation. His work on practical subjects, on fermentation and spontaneous generation, not only represent great advances in science, but they have opened new avenues into the heretofore undiscovered domain of scientific knowledge.

Louis Pasteur was born on December 27, 1822, at Dole, France. His father, Jean Joseph Pasteur, a tanner by trade, served as a non-commissioned officer in the Peninsular War and received the Cross of the Legion of Honor. Louis was the only son of four children. When young, his family moved to Arbois. Pasteur went to the Arbois primary school and later attended the College of Arbois. He was merely an average student showing a marked taste for drawing. Persuaded by the principal of the college to work for a degree, in the fall of 1838 Pasteur went to Paris to attend a boarding school, but was soon compelled to return home because, as he expressed it, of the loneliness in Paris. He again entered the College of Arbois, and during 1839 carried off many prizes. Because the classes here were not far advanced, the following year he went to the Royal College at Besancon. Here he taught physics and mathematics, receiving board, lodging and a small retaining fee and studied during his spare moments. He successfully passed his examination in the studies he pursued at the Royal College, and in 1842 took an examination to gain admittance into the Ecole Normale. Dissatisfied with the low average he received in his entrance examination, he resigned and decided to compete again the following year. During the interim he gave private lessons in mathematics and attended lectures on chemistry by J. B. Dumas, the great chemist. At the end of the year he took his admittance examinations again and was fourth on the

list for the Ecole Normale. Here he proved to be a satisfactory pupil, but did not distinguish himself by any exceptional merit. From 1844 to 1847 he was devoted to the study of chemistry. It was during this time that the topic of the day seemed to be the internal constitution of molecules and the arrangement of atoms in substances, which, though they are composed of exactly the same constituents, exhibit very different physical and chemical qualities. It was in 1844 that he had read of the work of Mitscherlich on the tartrates and paratartrates of soda and ammonia. The essential points in the report as given was that the chemical and physical qualities of the two substances were identical, but their action to polarized light was different. He proved to his satisfaction that the various paratartrates were composed of crystals that were disymmetrical (that is, the image reflected in a mirror could not be super-imposed on the crystal itself). He brought out this idea clearly by referring to the mirrored image of the hand: the image of the right hand as seen in the mirror is the left hand. He found that the paratartrates were disymmetrical, but that they possess two forms of disymmetry. By this discovery he was led to the theory that molecular disymmetry is the result of a certain grouping of the atoms of the molecule and you all are aware that this theory has had considerable weight on the later work on organic chemistry. This discovery not only was to make chemistry and physics, but supported a new science of stereo chemistry and indirectly was a great landmark in biology. In the first five months in the year 1848, four different writings were presented by Pasteur to the Academy of Science on the subject of crystallography. In the same year he was made Professor of Physics at Digon. In the month of January, 1849, he was appointed to the Chair of Chemistry at Strassburg. It is here he met the daughter of the rector of the academy, whom he married during the month of May of the same year. For the next number of years until 1853 he followed up researches in crystallography, and during May of the latter year he succeeded in transforming tartaric acid into paratartaric acid.

He proved that there existed various forms of tartaric acid—all identical from the point of view of their physical and chemical properties, save that they each had their special hemihedral facets and the corresponding rotary power. Such differences were also found by him to exist in all their compounds, each forming distinctive

marks, which were permanent and deep. The first effect was that of gaining for Pasteur the Cross of Chevalier of the Legion of Honor and a prize of 1500 francs awarded by the Pharmaceutical Society of Paris. His growing reputation led to his nomination in the fall of 1854 as Professor and Dean of the newly created Faculty of Science at Lille.

He dwelt more along such lines when he studied mallic acid and asparagin and their compounds.

His next great study was when he began to attempt to explain to his satisfaction a correct reason for fermentation. Lactic acid fermentation first interested him because in many of the industrial fermentations there is produced a secondary product, amyl alcohol, The latter is endowed with rotary power and capable furthermore of forming several crystalline combinations which do not show any hemihedrism. This was the first exception which Pasteur had encountered in this law of correlation between hemihedrism and the rotary power. It is in his writings on Lactic Acid Fermentation, published in 1858, that Pasteur presents the idea that a specific ferment is associated with each fermentation. He shows that there is a disproportion between the weight of the ferment produced and the weight of the matter transformed and he mentions that if two organisms simultaneously invade the same medium, the one which is best adapted to the existing conditions continues to flourish and produce the characteristic end products.

During one of his discourses at Lille he was approached by the father of a student who came to him to explain the difficulty he was encountering in the manufacturing of alcohol from beet. Pasteur determined to study all the phases in the manufacturing of alcohol. He followed out minutely the fermentation of beet juice.

It was during the beginning of all of these studies on fermentation that he accepted the nomination as administrator of the school and sub-director of science studies at the Ecole Normale in Paris. It is here where he arranged for a small laboratory at his own expense and where he followed up his investigations on alcoholic fermentation.

In 1860 he published his memoir on alcoholic fermentation. Here he points out clearly that glycerin and succinic acid are formed in considerable quantities and almost as constantly as the principal products of the fermentation. He states that fermentation is cor-

relative with life, with the organization of globules, not with the death or putrefaction of these globules as was believed. Throughout his entire writing his tone is one which leaves the writer with the thought that the entire question of fermentation is one not of decomposition and death, but of development and life.

After this thorough work on alcoholic fermentation was well under way and resulted in practical observations which proved his theoretical assumptions, he returned to lactic fermentation and started other experiments along these lines. In some of his writings he shows illustrations and describes in detail the separate and distinct ferments which cause lactic acid and alcohol. But a distinct surprise was in store when he experimented and was able to produce a butyric fermentation. Bodies similar to the non-motile alcoholic and lactic ferments (which were considered as vegetables) were not present. The butyric ferment he first called vibrios, and because of their motile nature regarded them as of animal origin. Little did he suspect that this discovery would soon open a new world, the kingdom of the Bacteria. Another important fact that he observed was that the butyric vibrio lives in the absence of oxygen and, in fact, fears its contact, thus the introduction of the idea of anærobic life.

In all his works and writings on fermentation, he presents the problem in such a clear way as to definitely prove that fermentation is a specific phenomenon, due to the existence and development of a particular organism specific for each different type of fermentation.

Now that he had proven that ferments cause fermentation, the question soon was asked, "How do the ferments get in? Are they organized at the expense of dead organic material or are they produced from organisms like themselves?" It is here again that Pasteur steps in and definitely proves to the partisans of spontaneous generation the germ theory. His familiarity with the small organisms, which he showed the world how easily one could manipulate them, definitely and convincingly proved the existence of living organisms in the air and how they in co-operation with the oxygen of the air assisted in the many fermentations. These germs so resistant are indeed widespread. He even determines the temperature necessary for their destruction and points out the necessity of flaming all receptacles used in microbiology—a technique still in vogue today.

It was during his experiments on micro-organisms in the air that he mentions in his communications to the Academy of Science

the use of cotton as a filtering agent to remove bacteria, the advisability of heating milk to 110° C. or 112° C. or one and a half atmospheres to kill all the germs, and if their re-invasion is prevented, no alteration will occur: thus the introduction of steam under pressure or the Autoclave. He makes mention of the existence of germs that produce spores, as the B. Subtilis, and shows that boiling at 100° C. is not sufficient to destroy this organism, but that it must be submitted for a half hour in an autoclave to a temperature of 120° C. He even states that blood, urine and body fluids most liable alteration, if removed with suitable precautions from normal healthy living animals can be kept without alteration, provided that the air in the immediate environment is freed from germs; and finally he clearly demonstrates that the dust in the air contains the germs and that where the air was more dust laden the more numerous the germs. It is in the latter communication that he shows the direction of his thoughts when he says: It is very desirable to carry these researches sufficiently far to prepare the way for a serious inquiry into the origin of disease.

In 1861 the Chemistry Section of the Academy of Science awarded him a prize. In 1862, after his third attempt, he was nominated member of the academy in the section of mineralogy.

Pasteur's studies on fermentation included a thorough consideration of the technique and results obtained in the wine, beer and allied industries. He showed clearly that the so-called diseases in wine, etc., that is bitterness, acid taste, ropiness, were due to the presence of foreign germs, and he set about and showed how to correct these faults. The practical consequences of his discoveries equalled their theoretical promise.

He soon interested himself in the changes in the alcoholic liquids which lead to the formation of vinegar. His experiments and observations which were announced in two communications to the Academy of Science in 1862, and in an article in the scientific annals of the Ecole Normale in 1864, started one of his greatest discussions and conflicts with Liebig, the eminent German chemist.

Pasteur gave conclusive proof that what was necessary was the Mycoderma Aceti. This organism he proves to be singularly prolific, and possesses a marked aerobic character. It was here with the collaboration of Chassang, Professor of Greek, that the two new words were coined: "aerobic," and to characterize the opposite func-

tion as in the vibrio butyricus "anaerobic." This acetic micro-organism takes the oxygen from the air and transmits it to the alcohol for oxidation. It is here that Pasteur points out the possibility of what may be regarded as a diseased condition in so small a creature. If the conditions for proper development are not present, the organism does not convey the proper amount of oxygen and an aldehyde is the result. The latter is practically observed by the product yielding a disagreeable odor. On the contrary, there is also the possibility of the acetic acid being further oxidized into carbonic acid and water. In 1867, at the invitation of the Mayor and the President of the Chamber of Commerce of Orleans, Pasteur went there and taught his method to the manufacturers of their town. He restored security to the Orleans vinegar manufacturers, who could control and regulate the production, and thereafter succeeded in making rapid progress.

Pasteur now reached one of the turning points of his life. For a long time he seemed to connect the theories of fermentation with that of disease and this relationship became still closer when he convincingly proved that living cells controlled the processes of fermentation. It seemed, as was pointed out in many writings by his associates, Pasteur hesitated coming in contact with diseased conditions in the higher animals, because he always claimed he was not a physiologist, though he did attend a course of lectures given by Professor Claude Bernard.

In the early part of 1865 Pasteur was compelled to encounter the problem he hesitated over so long a period, due to the insistence of his close friend, M. Dumas. He was asked to take up the study of the silkworm disease. A mysterious malady was first noted about 1850, which affected the silkworm and was ruining the silk ihdustry of France. Once a colony of silkworms were attacked, complete ruination followed, and it then became necessary for the silk farmer to obtain the eggs of an unaffected race of worms from some other country. Even the latter after a few generations became contaminated. The most careful investigation failed to reveal any method of overcoming successfully this condition. In 1863 the French Government offered to pay a half million francs to an investigator who claimed to have found an efficient remedy for the disease, but even this offer was to no purpose. Hesitatingly Pasteur finally accepted the mission offered to him. Pasteur had only the vaguest idea of

sericulture. He however soon acquired a fragmentary knowledge of the general structure of the larvae of insects by causing the latter to be dissected in his presence and obtained as much information as he could from the latest published works on the subject. In June, 1865, Pasteur set out for the silkworm district of France. His researches lasted for six years. Pasteur showed that the failure of the silkworm was due to two diseases, Pebrine and Flacherie, which were directly communicated to the eggs of the worm. The young from the latter are thus diseased and they by crawling about communicate it to others. To prevent the disease it was necessary to procure absolutely healthy eggs and then prevent their contamination by diseased worms. The eggs of worms which showed signs of infection were to be rejected. Pasteur thus discovered the cause and course of the disease and presented the foregoing simple suggestions as a method of preventing its recurrence. By the introduction of these precautions the silk industry of France was brought back to prosperity.

The six years which he spent in studying the silkworm disease were the hardest days of his life. Fate had dealt him a number of blows which had made his work doubly difficult. He had aready lost his mother and his eldest daughter. At the outset of his work in June, 1865, he was summoned to his dying father and arrived only in time to attend the funeral. In the month of September of the same year he lost his youngest daughter, Camille, who was barely two years old, and in May, 1866, his daughter Cecilie died at the age of twelve and one-half year. Of the five children who had been an inspiration to him, two remained.

On July 1, 1867, he was summoned to Paris, where he received a prize awarded to him for his studies on wine. During this period there were some disturbances that occurred at the Ecole Normale. The school was reorganized. A complete change of faculty took place and Pasteur was compelled to drop out. He, however, was soon appointed Professor of Chemistry at the Sarbonne. In April of 1868 he saw to his great joy the beginning of the building of the laboratory of "chemical physiology," as he termed it. The strain of work and the worry of all the controversies Pasteur had at this time was too great, and in October of 1868 he was seized with apoplexy. He could not speak and his left side was paralyzed. His convalescence was slow but steadily progressive, and it was not until the

early part of 1869 that he was able to get about. He never completely recovered from his illness and was always afterward somewhat lame.

A few days after Pasteur had left Germany in July, 1870, where he stopped to visit Liebig, war was declared. His son aged eighteen soon enlisted and Pasteur with his wife and daughter withdrew to his old home at Arbois. He was so highly incensed at the outrages committed that in January, 1871, he returned to the Dean of the Faculty at Bonn the diploma of Doctor of Medicine, which had been awarded him in 1868 by the university of that town in recognition of his work. During this period he refused an offer by some Italians for a directorship of a laboratory in Milan or a chair of chemistry at Pisa.

From 1871 to 1876 Pasteur did considerable work in improving French brewing. In 1873 he was elected a member of the Academy of Medicine in the section of free associates. He was neither a doctor nor a veterinary surgeon, but many of the members appreciated the importance of his work. At the time he entered Pasteur had more or less fixed ideas about many things pertaining to human pathology because he attempted to apply his own discoveries to them.

Ideas about infection were confused and more or less opposition was constantly being introduced against the attempt of connecting Pasteur's ideas respecting fermentation with that of diseased conditions. About this time Pasteur began to read more and more of the works of men in medicine, surgery and allied sciences. He seemed to be especially interested in the studies which Davaine was pursuing upon anthrax. The Bacillus Anthracis, the causative agent of this disease, was first observed by Rayer and Davaine in the blood of sheep who had died of this disease in the year 1850. Other workers observed these small rods not only in dead animals but also in the blood of living animals suffering from anthrax. It seemed that none of the workers realized that these small rods were the causative agents of anthrax. In 1861 Davaine had read Pasteur's brief communication on butyric fermentation, in which article a rod-shaped organism named a vibrion is mentioned as the specific cause of such fermentation. He immediately set out and proved definitely to the satisfaction of all that this rod which he called a bacteridium was the cause and the sole cause of anthrax. In 1869 Pasteur had described so-called cysts in the vibrion of Flachery, a disease found in silkworms, and he had further demonstrated the increased resistance of

these organisms due to the presence of these cysts. Koch gave an analogous demonstration when he showed the presence of the anthrax spores in 1876. Critics were rising from all sides, and many hesitated to believe the work so far accomplished. It was in 1877 that Pasteur with the collaboration of Jobert made his first experiments on anthrax. Previous observations and experiments had taught him that if he could sow in a suitable medium the blood of the diseased animals taken as it circulates in the veins, he would be able to obtain a pure stock of the anthrax bacilli and keep them for an indefinite time so as to study them more carefully. He succeeded in doing this and used a neutral or slightly alkaline urine as the culture media. It is interesting to point out here as mentioned by Duclau that Pasteur being neither a physician nor a veterinary surgeon, the history of any disease as a disease did not interest him. What he studied was not so much the anthrax disease as the anthrax bacteridium. He had at his command the method of obtaining pure cultures, and thus he had the big secret in being able to study the physiological properties of organisms, to compare them in their pathological reaction and to definitely establish the etiology of a disease.

During 1770 to 1880 he devoted much time to the study of anthrax, even traveling through infected districts. In his conclusions he mentions the many peculiar characteristics of the anthrax bacteridium. He showed that a number of diseases traveling under different names in animals were nothing more than one and the same disease—anthrax. He even demonstrates that the carcasses of animals may aid in the distribution of the disease if they are not buried deeply below the surface of the ground. It is also here that Pasteur introduces the first example of what was to be called bacterio therapy.

During the work on anthrax some observers in inoculating animals with putrid anthrax blood found that death was quickly produced, but all the symptoms were similar to anthrax. Bacteridia were not found in the blood. Davaine answered them and claimed that the disease that they had introduced was not anthrax and pointed out in many ways the difference of the two conditions. His arguments though weighty were not convincing. Pasteur decided to repeat the experiments and set out to study this condition. His investigation immediately revealed a number of important facts. He

clearly showed that the condition which developed was a different disease. The latter was caused by a common bacillus which he calls the vibrion septique. This is known today as the Bacillus of Malignant Edema. He shows that the period of incubation is shorter and death results more quickly. He made haste to study the physiological characteristics of the organisms and immediately pointed out that it was an obligate anaerobe and a marked gas producer. He goes into further detail as to the different characteristics and the different diseased conditions which it causes.

Mention should be made at this time of his celebrated lecture delivered at the Academy of Medicine on April 30, 1878. In his own name and that of his collaborators, Jobert and Chamberland, he elaborated his "germ theory and its application to medicine and surgery." In the suggestions of Pasteur one can constantly foresee the aseptic method. Prevention is better and surely more certain than cure. Without professional experience, but with the conviction of an authorized experimenter Pasteur ventured to make assertions based upon actual observations. Pasteur dwelt more and more into researches which dealt with facts pertaining to human pathology. In 1879 he examined pus from boils and showed the presence of a microbe which he was able to cultivate. The latter appeared microscopically as a mass of rounded granules comparable to irregular bunches of grapes, whence the name staphylococcus which it received. In making these observations Pasteur made frequent visits to the hospitals. He shortly proved this same organism as the cause of osteomyelitis.

At about this time considerable discussion had begun at the Academy of Medicine on Puerperal Septicemia. Pasteur followed these discussions with keen interest and set about to examine discharges and secretions from such infections. He found in all instances the presence of a microbe which has the appearance of strings of beads (the organism known today as the streptococcus). He had no hesitation in declaring this organism to be the commonest cause of infection in women after delivery. In one of these discussions Pasteur declared it is the doctor and his assistants that carry the microbes from a sick woman to a healthy one.

The year of 1880 was a strenuous one. In April of this year he addressed a note on Bacterial Nature of Plague. In October he read an address at the Academy of Medicine on Vaccinia and Variola. In December the same year, he began his work on rabies—but

his greatest success during this year was his work on chicken cholera. Pasteur succeeded in finding the germ which was the cause of this disease and first observed in 1869 by Moritz, a veterinary surgeon. This germ was successfully cultivated on artificial culture media and always produced the characteristic disease when inoculated into fowls. The course of his experiments was interrupted by a period of vacation. On his return he was annoyed when it was found that these cultures failed to produce the typical symptoms of the disease when injected into the fowl. To his surprise the inoculations instead of proving fatal, produced but slight symptoms and the fowls shortly thereafter recovered. After some trouble Pasteur procured fresh cultures of the chicken cholera organisms. Fresh fowls when injected with the latter soon died, exhibiting all the characteristic symptoms of chicken cholera. But when these fresh cultures were injected into fowls which had previously been inoculated with the long-standing cultures, no characteristic symptoms were produced. It seemed that those fowls that suffered from the mild form of the disease produced by the old cultures were protected from further attacks of the disease.

One of the great mysteries of medicine had thus been revealed. The attenuation of a virulent micro-organism (that is the loss of its disease inciting power) had been attained by the increased age of the culture. Pasteur soon introduced practical methods of immunization in which he shows that the attenuated culture when inoculated gives the same disease but not in the fatal form, with the result that after recovery the animal is able to withstand the inoculation of a virulent strain of the same organism. He immediately began to practically apply his new theory by providing old cultures for the inoculation of fowls in districts where chicken cholera produced serious ravages.

The inoculating substance was called vaccine and the method practiced of immunization was called vaccination, so as to honor the English physician Jenner, who first introduced methods of inoculation to protect against smallpox.

Mention was made previously that Pasteur was working off and on on anthrax. With renewed enthusiasm he proceeded to produce a vaccine material for anthrax. Here he had a more intricate problem as the anthrax bacillus is not weakened with age because it is capable of producing spores. His method of attenuating this organism consisted in exposing the cultures of the organism for vari-

ous lengths of time over a period of successive days at a temperature slightly higher than the maximum temperature at which the organism will grow. After many difficulties and a number of investigations Pasteur succeeded in immunizing sheep and other animals against anthrax. The Society of Agriculture of Melinn had proposed to Pasteur a public trial of this new method. In was in May, 1881, that Pasteur gave this public demonstration and conclusively established the value of anthrax vaccination.

In August of 1881 Pasteur attended the International Medical Congress in London, and in December the same year he was elected a member of the Academie Francaise.

From anthrax Pasteur went on to the study of swine erysipelas, rouget, swine fever or red disease of pigs, as it is at times known. One of Pasteur's collaborators, Thuillier, isolated the causative agent, and within a few years Pasteur had established a method of protective treatment.

At about this time Pasteur began to receive many medals from different societies and communities who wished to show their gratitude to him. In 1883 the national recompense which was awarded to Pasteur in 1874, was raised from 12,000 to 25,000 francs. On July 14th, of the same year, he was invited to be present at the placing of a commemorative tablet on the house in which he was born at Dole.

The government offered Pasteur the Grand Cross of the Legion of Honor in tribute to his great discovery of splenic fever and anthrax vaccination. This he condescended to accept only after one condition was met, and that was an award of the red ribbon or cross for his two collaborators—Chamberland and Roux.

While the various researches were being closely watched by Pasteur one study seemed to be placed above all others. This was Pasteur's work on hydrophobia or rabies. Human rabies is as a rule caused by the bite of a mad dog. It does not appear in all those bitten, but once it shows itself it is almost invariably fatal. The mortality which it causes is slight, but the great dread is the hold which this disease has on the imagination. At times on account of the latter conditions the symptoms that appear are often horrible. It was due to this fact that in December, 1880, Pasteur took in hand the study of rabies. As he began to observe a number of cases of rabies in animals and in humans he soon became convinced that the infection has its seat in the nervous system and particularly in the medulla oblongata. While working along these lines, he examined

the saliva of those who had died of rabies. He succeeded in obtaining an organism from one of these cases in the early part of December, 1880. He further succeeded in culturing this organism, but found that on inoculation into various animals, symptoms were produced entirely different than ordinarily found in rabies, and different than observed on inoculation by any other known microbe. Following up the study of this new organism he found it in the saliva of people who had died of any disease as well as in the saliva of normal healthy individuals. He soon thereafter came to the conclusion that this organism as well as the disease which it produced had no connection with rabies. It is the same organism which Sternberg in this country reported the same year. A few years later it had received the name of pneumococcus after Frankel, who demonstrated its presence in the lungs of persons who had died of pneumonia.

Pasteur, therefore, was compelled to use the medulla oblongata, as he felt assured the causative agent of rabies was confined to this tissue. By means of the latter he successfully produced typical rabies in other animals. He further proved that the virus was present not only in the brain, in the bulb, but in the entire cord and in the nerves. Unable to definitely establish this specific causative agent he continued his researches with the idea of attenuating this virus and estabished a method of prophylaxis. By a series of passage of the virus from rabbit to rabbit, he finally succeeded in obtaining a uniform virus which possessed a fixed virulence, producing rabies after only a one week period of incubation. Further passage from animal to animal did not tend to further reduction of the incubation period. His method of attenuation in this instance consisted of suspending the cords (specifically of fixed virulency—therefore known as virus fixe) in a series of flasks, at the bottom of which there is placed several pieces of potash. He found that the longer the period of time in which the cord remains suspended, the less virulency did the particular cord possess; and, finally, if exposed for a period of fifteen days all virulency seemed to have disappeared. His method of inoculating humans with these cords starting with those that possess slight virulency and increasing not only the dosage but also the use of more virulent cords was soon introduced. Long and bitter was the opposition to the introduction of this so-called Pasteur's method of treatment. The attacks were numerous, and all seemed to refer to the failure of finding the causative agent, but

the existence of a claim of having discovered a cure. In spite of all wherever the Pasteur treatment for rabies was introduced the number of deaths following the bites of rabid animals were greatly reduced. Most all countries and many of the governments after careful investigations officially recognized the value of the Pasteur treatment as it became and is still known today and introduced it in their respective countries. Pasteur Institutes sprung up all over the world in many of the leading countries, and Pasteur lived to see the crowning of his work on rabies, when in November, 1888, the Pasteur Institute in Paris was opened. Today it is estimated that there are close to seventy such Pasteur Institutes.

In 1884 Pasteur had represented France at the International Medical Congress at Copenhagen, Denmark. The enthusiastic demonstrations which took place in his honor were numerous.

When the Pasteur Institute was finally completed, due to the hearty support of both rich and poor in subscribing to the building fund, he moved his quarters to the Institute. He, however, was ill and weary. He attended the hydrophobia clinic almost daily and superintended the production of the vaccine material. At the same time he was constantly offering suggestions to his assistants, especially Dr. Roux and Dr. Yersin, who were pursuing the study of diphtheria. Later when Dr. Yersin began his wonderful work in Asia, working in areas in which Bubonic Plague was epidemic, Pasteur followed with great interest the communications sent to the annals of the Pasteur Institute. It was Yersin who discovered the causative agent of Bubonic Plague.

During May of 1892, a committee was formed in Denmark to celebrate Pasteur's seventieth birthday on December 27th. The movement spread to Norway, Sweden and finally to France, where a committee was formed for raising subscriptions towards "Offering a remembrance and a tribute to their illustrious patriot on the occasion of his jubilee." On December 27, 1892, one of the greatest receptions ever given any living man took place in France. Many men from all walks of life made speeches and presented addresses. It would be impossible to attempt to mention even some of the important ones, but a few of the remarks with which Lister greeted Pasteur are of interest:

"Truly there does not exist in the whole world an individual to whom medical science owes more than to you."

"Your researches on fermentation threw a powerful light, which has illuminated the dark places in surgery and has changed the treatment of wounds from an uncertain, empiric and too often disastrous business into a scientific and certainly beneficial art. Thanks to you, surgery has undergone a complete revolution, which has deprived it of all its terrors and which has increased its efficacy to an almost unlimited extent."

It was in September, 1895, as Pasteur's career was coming to its close, that he saw about him the entire routine of the making of diphtheria antitoxin, the discovery of which was announced the year before. On Saturday, September 28, 1895, at 4.40 in the afternoon, Pasteur passed away very peacefully.

Pasteur's ashes repose in a beautiful chapel situated below the main entrance, a little lower than the ground floor, of the Pasteur Institute. The walls of the chapel are inscribed with the scientific triumphs of the master whose ashes repose there. It is a striking array of headings, representing a great step forward in science.

His devoted wife died September 24, 1910.

There is said to exist a constant warfare between science and religion. It may be that there is such a conflict, but if we turn to the pages in which are recorded the sayings of the real great, we are inclined to believe that such warfare, if at all, is only present in the narrow minds of the lesser lights.

It is interesting to note the simple expressions in which Pasteur at times attempted to explain his ideas about religion. In his address as newly elected member to the Academy of Science, the following remarks are quoted from his address: "Everywhere in the world I see the expression and idea of the infinite. Owing to it, belief in the supernatural is found in the bottom of every heart. The idea of God is a form of the idea of the infinite." He refers to the Greeks and says: "It is they who have bequeathed to us one of the most beautiful words in our language, the word enthusiasm—an inner God. The greatness of human actions is measured by the motives which inspire them. Happy are those who carry within them a God, an ideal of beauty which they obey, the ideal of art, the ideal of science, the ideal of country, the gospel idea of virtue. Those are the living sources of great thoughts and great actions. All are lit by reflections of the infinite."

Pasteur encountered many difficulties and many obstacles, but with the high quality of thought which constantly guided him he al-

ways outflanked these obstacles. Unlike the generality of great men, he, however, enjoyed the meed of almost unstinted appreciation during life.

Pasteur looked upon the cult of great men as the great principle in national education, and he constantly advised students to worship great men.

He was always irritated when scientists involved in arguments over their problems brought in for consideration the question of nationality. It was at a banquet at the close of the International Congress on Sericulture held at Milan that Pasteur pronounced the words so often repeated: "Science has no country, but the scientist has one."

Those of us who are interested in research and in teaching may obtain considerable food for thought from some of the following remarks attributed to Pasteur. In his Lille speech, the sentence "in the fields of observation, chance only favors the mind which is prepared," was particularly applicable to him. "At the beginning of an experimental research on any fixed subjects, wings must be given to the imagination. At the moment for drawing conclusions and interpreting collected observations the imagination must on the contrary be made to give way and submit to the actual results of the experiments."

He wrote in the preface to his "Studies on Silkworm Disease": "It is the glory of the man of science to esteem discoveries which at their birth can only be appreciated by his equals far above those which immediately earn public favor by instant application; but in the face of misfortune it is equally glorious to sacrifice everything in order to try and be of assistance."

Pasteur said to his pupils, "Without theory practice is but the routine of habit. Theory alone can awaken and develop the spirit of invention."

In his communication on February 10, 1862, to the Academy of Science on the "New Industrial Method on the Fabrication of Vinegar," he gave the following warning:

"As it often happens that scientific principles published by their discoverers are made use of by others, with the addition of apparatus or some insignificant modifications, for obtaining patents of invention, I have, by the advice of competent persons, and before making my communication of February 10th, taken out a preliminary

protection forestalling the patenting of all inventions to which my work may give rise, and I add that I am resolved to let this lapse from today for the benefit of the general public."

There are many examples of Pasteur's insight, his ability to discover and state a problem, of the patience with which he gathered together information. He lived in advance of his time. He lived with his thoughts without being a dreamer for his dream so regarded at the beginnning, eventually bore fruit.

It is, therefore, fitting that during this month scientists and everyone are uniting the world over to honor this genius on the centenary of his birth, he whose work has proven of such great and practical utility for mankind, and whose knowledge and discoveries are even today beginning their career of developing suggestions and thoughts to scientists.

"THE CRISIS IS UPON US."

An Address.*

By John Uri Lloyd.

Mr. Chairman and Friends: Nothing have I prepared to offer as an address. Months ago I started to write one on a very vital subject, but when nearly through came the crash of this war. Then I shoved the paper back on my desk, because I felt, as I know you also do, that these be not times for studied formality, made under the cold touch of a laboratory in which my life is spent. Let me informally speak that which comes now, touching perhaps some phases spoken before, but of necessity not until now systematically formulated.

It has been said that if there be any inflexible law, it is the law of exceptions. Should a man lay down a rule to follow through life, he will find if he lives long enough, that there comes a time that there must be an exception to previous idealistic processes of reasoning, and, necessarily, if he be yet elastic in thought, change in action follows.

*Delivered informally at the meeting of the National Eclectic Medical Association, Detroit, Mich., June, 1918.

Let me take as my text, the expected (as our people see therapeutic problems) has unexpectedly (as some others view them) happened.

Listen! Thirty-five years ago it was proposed to introduce a pharmacy law in the state of Ohio. A few pharmacists, in Cincinnati, Dr. Greve, a member of our society, and myself—probably first foresaw the wrong the pharmacy law, as introduced, would do, both to the cause of the people and of pharmacy. As we looked upon it pharmacy laws, if instituted, should be designed not to help the colleges alone, but primarily, continuously and eventually, the people. Many times did we go to Columbus and endeavor, by the aid of the united pharmacists of Ohio, to get what we believed to be a fair pharmacy law, designed to care for the people as well as for the college interests. And we succeeded. The argument made was simply a statement of fact to the following effect:

If the proposed draft is passed, as presented, and becomes now a law in Ohio, there will be few pharmacists left excepting in the large cities, and the majority of these will be put out of commission. Very few pharmacists have college of pharmacy diplomas; comparatively few can leave their places of business now to attend college. Not a doctor in the State of Ohio, if this law passes as introduced, will be permitted to supply medicines to the people. Not a cross-roads general store or grocery can carry such simples as copperas, or bluestone, or castor oil, or Epsom salts; indeed, general chemicals used as dyestuffs.

We insisted that we not only favored regulation of pharmacy where ignorant or harmful processes might work to the people's injury, but believed in the utmost practical education for pharmacists.

We began our argument as a minority, which in the end became a majority, both with pharmacists and our lawmakers. The law, as passed, was at that date a balanced law that, based upon the then present conditions, favored progress.

A few of us foresaw the future—all knew the present. The future was theoretical—the present a fact. By dwelling upon possibilities based upon the present, we were able to indicate the probable future.

One of our amendments was to the effect that a person not a pharmacist might properly own a drug store, and, under balanced restrictions by a state pharmacy board, employ competent pharma-

cists. Just then a forceful example pended as a text. A prominent pharmacist in Cincinnati (K. B. Ashfield) died and left his two stores in the hands of his widow. Under the law introduced by the College of Pharmacy, she would be compelled at once to close the doors of those two establishments or sacrifice her heritage. The law-makers saw the force of our argument.

As is the case when a person attempts to stem ultra-enthusiastic effort, especially when personal interests are concerned, we had to meet the charge that we were opposed to higher college education. This was an error, because the prime mover, Dr. Greve, was a long-standing trustee of the College of Pharmacy, and I occupied the chair of pharmacy. With few exceptions, the college trustees and professors finally became our allies. We were all in favor of education, but yet argued that the colleges of pharmacy (university departments of pharmacy had not yet come into their responsibility) could gradually bring the entire practice of pharmacy into the hands of parties professionally educated and qualified. We counseled balanced effort that would bridge the present, and in the end would prove effective in all possible educational pharmaceutical directions.

Now to the application of this old-time text. Medicine is in some regards in the position pharmacy occupied forty years ago. The law-maker is besought to care for all concerned—colleges, universities, above all, *the people*. Let us not underrate their responsibility. Let us not shrink from our own responsibilities.

It is often difficult for persons concerned in purely academic phases of education to distinguish between idealistic aims and practical possibilities. Nor is it possible for an enthusiastic member of a dominant party to tolerate the opinions of a minority. Let us give an example:

Five years or more ago it was my privilege to sit by the side of a man known as a great educator in medicine. This man stood second to none in this cuntry in his earnest belief in the *immediate* application of idealistic "higher medical education." He was honest, energetic and self-sacrificing. He believed every word he said. In the discussion that occurred, I spoke as candidly on therapeutic processes as I had thirty years before to the Ohio legislature on pharmacy problems. Said I, concerning enforced "higher" medical education: "If you keep on with what you denominate higher medical education, and enforce restrictive laws to the limit, you will reap the opposite

of your ideals. Not only will you fail to accomplish for the people, but I fear will put the medication of this country into the hands of the so-called *patent medicine men.* I am an enthusiastic believer in university education as regards exact sciences and fundamentals, but I am not a believer in indiscreet processes that, unwisely applied, limit or disturb the country's opportunities and prohibit freedom in thought."

"What do you mean, Mr. Lloyd?" he asked.

I replied: "All the university departments in medicine of this country cannot, under the proposed plan, replace physicians who annually die. Nor are there applicants now ready to take the proposed courses. In my judgment, those who graduate under the proposed plan will have advanced opportunities as *specialists,* but this very fact will lead them to locate as specialists in our cities. If this surmise is proven correct, I would ask, where will rise the physician to care for the sparsely-settled desert or mountain? In my opinion, a loved one in a hamlet on the desert is as precious as he who lives in a palace. To provide self-sacrificing physicians in sparsely-settled locations is as much a charge of our lawmakers as to care for him living in a palace. No law should be either instituted or enforced that does not care for both, if it cares for one.

"As an example, I have in mind a location in Kentucky where a father put his all into the physician schooling of a boy, according to this extended education scheme. He graduated with honor, and we are all proud of him. Did this boy go back to his crossroads home in Kentucky to practice medicine? No, he became a specialist in a great city. Six years of time had been spent as well as his father's fortune. He could not afford to go back to the limited field of the crossroads, where patients afflicted in the direction of his specialty were as scarce as odd rows of corn on the cob.

"In the furtherance of your worthy aim, denominated 'Higher Medical Education,' you should comprehend that during the transitory interval the supply of physicians must be maintained, not in the cities alone, *but in the whole country.* May I not ask you to permit me to use the term 'balanced medical education' or 'advanced medical education' instead of *'higher* medical education?' Is there any education *higher* in its sacrifices for humanity than that of the self-sacrificing physician of the olden time, qualified to the limit in general practice?"

This was his answer: "Mr. Lloyd, if we cannot have a doctor of the highest qualifications at the crossroads, I believe these people should have no doctor at all."

"This view I consider almost criminal," was my reply. "Listen! My family physician, Dr. R. L. Thomas, who followed in my family Dr. Locke, I consider, as a family physician, second to no graduate who has passed this 'higher' education program. When he visits a loved one sick at my home, I have all the confidence in his care and his advice that I would have in any one. He spent two years in a medical college that believes in therapeutic action of properly selected remedies and went immediately into active practice. But previously, he had two years under a qualified preceptor, versed in directions that make the practice of medicine a successful family practice, and he has now over thirty years of subsequent experience. He knows how to treat disease, he understands materia medica, and he is competent to judge as to when an ailment needs a specialist. And yet your view concerning the term 'highest' would discredit such men as these.

"Listen! We have already many advanced university specialists in surgery, in microscopy, in involved diagnoses, and in other sections. As a rule, they are located in cities, or in hospitals and sanitariums. Every one is proud of them. A wonderful opportunity for such phases of education does a university offer. The family physician does not pretend to be ultra-expert in all such specialties. The great province of the university that we all uphold, is (or should be) to extend the field of exact knowledge, to teach applied fact, to permit of independent thought concerning therapeutic opinions, and to serve humanity.

"Let me now tell you what *unbalanced* processes, idealistic to the degree in an academic sense, will, in my opinion, accomplish. Before comes a supply of physicians for America under proposed processes, famine in physicians must occur. As a result, *the country will be turned over to the cults, and our people medicated by the patent medicine advertisers.* And, in my opinion, there will be no freer supporter of excruciatingly long and expensive medical courses than the so-called patent medicine man and his advertising publishers. Why should not this be the case? Every section of the country that, by restrictive processes, has no physician, is naturally turned over to

almanac and advertising literature. Is it not to the interest of the home-cure *business* that there should be *no doctors?*"

This ended our discussion, which was not personal, but yet intensely earnest. I accepted his sincerity in behalf of hopeful medical advancement, but did not believe in his methods of procedure. Nor do I yet. In my opinion, he accepted what I believed to be unwarranted conclusions, in which he surely considered me erratic,—"irregular."

Behold! The apprehended crisis came upon us. One by one, during recent years, the all-sufficient doctor, the faithful family physician of the olden time, has been passing away. Too often, no man is there to take his place. Standard medical colleges, the outcome of a century's effort, colleges that graduated the teachers of today in both college and family practice, and that, were they still in existence, would be feeders of the university advanced special students, have, under methods rashly (unwisely) adopted, one by one, closed their doors. Only a few are left. The Medical College of Ohio (Cincinnati) is closed. The Miami Medical College is closed. They have given their honored names to the University of Cincinnati. The College of Medicine and Surgery and the several other colleges of medicine in Cincinnati, excepting the Eclectic, all are closed. Seven Cincinnati medical colleges have gone out. Surely they were not all unworthy. Excepting the University Medical College, which we all honor, only the Eclectic Medical College is left. Is such as this not the record of the whole country? Need one have been a prophet, or the son of a prophet, to foresee that the extinction of these institutions, without replacement, would breed a physician famine?

Think you that the family near that Kentucky crossroads needs no longer a doctor? Think you that the families on the plains of the West, where for fifty miles around, perhaps a greater distance there is now no physician, need no doctor? Think you that in the little home on the mountain side no doctor is now needed?

Surely our educators and lawmakers will arise to this emergency. They must do so. The care of the American home is a necessity. I bespeak not any relinquishment in general university education—rather in some directions its *enlargement,* in others curtailment. The term *university* permits not the thought *restriction.* I ask no open door for colleges to turn out either the ignorant or the charlatan. The term *college* prohibits such a definition.

In my opinion this problem should be met. Under a balanced system of medical education (mark well the word *balanced*) the family physician must again come into his own. The family doctor, who all admit has done such a great humanitarian work in his self-sacrificing calling, and who no man has a right to slur and despise, is surely not destined to become extinct.

CORN AND ITS PRODUCTS.*

By Freeman P. Stroup, Ph. M.

(Professor of General Chemistry at the Philadelphia College of Pharmacy and Science.)

Corn is a common Teutonic word, meaning originally a small, hard particle or grain, as of salt, sand, gunpowder, etc. Later the term came to be applied to small, hard seeds (barleycorn, peppercorn, etc.). In agriculture it is usually applied to the seed of cereal plants, and has often been understood locally to mean that kind of cereal which constituted the leading crop of the district, *i. e.*, in England, wheat; in Scotland, oats; in the United States, maize (Indian Corn).

Corned, as applied to meat, meant originally meat (beef generally) preserved by the use of salt in grains or "corns." At present the term applies to meat preserved by the use of solutions of salt.

Corn, as applied to the toe variety, is derived from the Latin "cornu," meaning horny, though not all toecorns are horny.

Indian Corn, Zea Mays, seems to be unknown in the native state, but is probably indigenous to tropical America. Small kernels have been found in ancient tombs of Peru. By some it has been thought to have come from Asia and is said to have been carried by the Arabs into Spain in the thirteenth century. A drawing is said to have been found in a Chinese work dating back to 1562, seventy years after the discovery of America by Columbus. It is not

*One of a Series of Popular Lectures given at the Philadelphia College of Pharmacy and Science.

figured on Egyptian monuments, nor was any mention made of it by eastern travelers in Asia or Africa prior to the sixteenth century. Humboldt and others do not hesitate to say that it originated solely in America, probably in Mexico, where it had been extensively cultivated for many years before Columbus' appearance on this side of the Atlantic Ocean. He found natives of the West Indies eating cakes made from the new grain which they called "mahis." Pizarro found the Peruvians using it for food and for making an alcoholic beverage. The Pilgrim Fathers found a cache of it back of Plymouth Harbor.

Botanically speaking, corn belongs to the grass family (order of Gramineæ) and is of many varieties, more than 2000 named varieties having been catalogued. These may be roughly grouped under five heads: the *Pop-Corns* (Zea Mays everta); the *Dent Corns* (Zea Mays indentata); the *Flint Corns* (Zea Mays indurata); the *Soft Corns* (Zea Mays amylaceæ); the *Sugar Corns* (Zea Mays saccharata), commonly called sweet corn. *Broom Corn,* the tops of which are used in the manufacture of brooms, belongs to a different class of grasses and will not be here considered.

Depending upon the variety, the weather conditions, the nature of the soil, the amount of cultivation, and other factors, corn grows to a height ranging from a few feet to twelve feet or more. Fabulous statements have come out of certain sections of the Middle West as to the height to which the plant has grown. The diameters of the stalks vary with the height, and the relative closeness of the plants in the field.

The flowers are of two kinds, the staminate or male flowers constituting what is commonly known as the tassel, and the pistillate or female flowers and their supporting stem and sheath constituting the ears. On any given stalk the staminate flowers mature first and shed their pollen before the pistillate flowers are ready for pollination. This prevents inbreeding and explains why isolated stalks fail to bear grain on the cobs. The tassels are borne on the ends of the stalks, the ears in the axils of the leaves. The number of ears on a stalk varies from one to three, rarely more. The pollen from the tassels is scattered by the wind and fertilizes the ears on neighboring and, sometimes, quite distant stalks whose pistils, collectively called "Corn-silk," are ready for pollination. If pollen grains come in contact with all the fibers of silk on an ear the em-

bryo grains attached to the lower ends grow and we have a so-called "well-filled ear." In order to ensure well-filled ears corn should never be planted in single rows but, rather, in plats, or "patches."

Some varieties of corn mature in two months from date of planting and some require as much as seven months. The nature of the soil and, particularly, the climate have much to do with the rapidity of maturity. Corn can be grown in the Tropics from the sea level to several thousand feet above sea level; it can be raised in the middle and south of Europe, but not in England, with any chance of profit. It is extensively grown in India and in the United States, and constitutes the most common crop of South Africa, where it is known as "mealies" and furnishes the chief food staple of the natives. It thrives best in regions where the rainfall annually averages around 30 inches, or in sections which can be frequently irrigated. All other things being equal, it thrives best when there is a succession of hot nights during the height of the growing season, the rate of growth often being so rapid that one "can almost see the corn grow." It has been estimated that 300 pounds or more of water are required to produce one pound of dry matter in the corn stalk.

Closely planted, either broadcasted or drilled, corn makes an excellent forage crop. Special varieties which grow rankly to form stalk and leaves, and known as ensilage corn, are widely cultivated, the stalk cut while still green and full of sap, stored in tall structures known as silos, where it undergoes fermentative changes, and from which it is fed to live-stock during the winter months when pasture is not available. The yield may be as much as 80,000 pounds to the acre. Where a silo is not available for storage the so-called "sowed-corn" is cut while still green and cured much as grass is cured for hay, and stored in the same way as hay is stored.

When corn is grown for the grain it is to yield it is planted in so-called "hills," three to five kernels in a hill, the hills 3½ to 4 feet apart in rows about the same distance apart; or the kernels planted at intervals of about 9 inches in rows, the rows being 3½ to 4 feet apart. Some growers plant only one or two kernels in each hill. Too close planting makes for small ears, too thin planting is a waste of ground and makes often for imperfect pollination. The seed-bed should be well prepared by deep plowing and thorough working to make it possible for the roots to penetrate deeply to give

firm anchorage to the stalks and to provide abundant storage for moisture, as well as to prevent too free evaporation of the moisture. All other things being equal, the more thoroughly and frequently the soil between the rows is loosened the better for the growth of the crop, not only as a means of keeping down weeds which impoverish the soil, but also as a means of destroying the capillarity of the top soil and thus preventing evaporation of the moisture stored in the lower layers.

Pop Corn Group.—To this group belong a number of varieties which yield kernels which, when mature, are small, rounded or elongated, hard, smooth, generally white to yellow, sometimes red to purple. When these are heated to about 150 degrees Centigrade (302 degree Fahrenheit) they explode, forming a very much enlarged, irregular, white mass in which the starch grains are no longer recognizable under the microscope, they having been ruptured in the popping process. The explosion of the starch grains is materially influenced by the water content of the grain, the popping proceeding most satisfactorily when the kernel contains 10 to 12 per cent. of moisture. This explains why corn of this kind which has been stored in a warm dry place does not pop well.

Sugar Corn Group.—To this group belong many varieties which yield grain in which the sugar content is more or less highly developed, as much as 8 per cent. in some varieties when in their prime, though much lower in others. The quicker-maturing varieties ("Early Corn") are usually less sweet than the slower-growing varieties ("Late Corn"). Sweet corn is usually eaten while in the unripe state, while the starch is still soft and the sugar content is at its maximum. The sugar which is in the kernel while on the stalk rapidly disappears after plucking the ear, and particularly after the removal of the outer leaf covering or husk; hence the corn should be cooked within a very short time after its removal from the stalk, if its greatest sweetness is to be enjoyed. People who get their sweet corn from city markets or from street peddlers do not realize what the owner of a kitchen garden enjoys in the corn line.

A great deal of sweet corn is made available for winter use by (a) drying in the sun or by aid of artificial heat the uncooked or partly cooked kernels, (b) modern dehydrating processes, and (c) canning processes.

The matured kernel of sweet corn (fit for planting) may be smooth and rounded or very much shrunken and wrinkled, the sweeter the corn the more wrinkled, usually, the seed. Most varieties yield a white seed, some yellow, some red to purple. There are hundreds of named varieties, but the differences between the characters of some are very slight.

It is interesting to note the arrangement of the kernels on the cob, as the grain support is called. Generally they are in rows running lengthwise of the ear, sometimes spirally, and sometimes not in rows but arranged very irregularly. The number of rows is generally even (the author has never seen an ear with an odd number of rows of kernels, nor has he ever met a person who could state positively that he or she had seen such an ear). The minimum number of rows ever seen by the author on any one ear was eight and the maximum twenty, though some authorities state that some varieties yield ears containing twenty-four rows. The number of kernels in a row varies very greatly, some so-called "nubbins" having only a very few, while fully developed ears may have fifty or more. An ear of fourteen rows of forty kernels each (an average sized ear) is thus seen to hold nearly 600 kernels, and when this number is multiplied by 3, the number of ears frequently found on a single stalk the result is so much greater than the biblical "sixty to a hundred-fold" that Indian Corn could not, by any possible stretch of the imagination, have been the grain referred to in the "parable of the sower."

Field Corn.—This is a name frequently given to certain varieties of corn whose ears are allowed to come to maturity and the fully ripened grain is desired. There are several types of field corn, the grain from each type having properties which adapt it for some special purpose or purposes.

Zea Mays amylaceæ, which yields a rather soft grain, is largely cultivated in the Southern States, and plays a very important part in the daily dietary of the population, particularly of the poorer classes, where it appears on the table in some form or other generally at least once a day. Hominy is generally made from this variety of corn.

Zea Mays indurata (Flint Corn) and Zea Mays indentata (Dent Corn, so named because of the dent on the outer end of the kernel) constitute the chief types of field corn grown in the

Northern and Western States, and constitute the bulk of the annual great American corn crop. The 1921 crop, according to statistics compiled by the Department of Agriculture, was more than three billion bushels. Because of extensive drought in much of the so-called "Corn Belt," this year's crop, as forecasted by the Department of Agriculture statisticians, will be about 225 million bushels less. The sweet corn and pop corn crops are not figured in these estimates. Upwards of a hundred million acres of ground are annually devoted to corn culture, which means an average production of thirty bushels per acre.

Harvesting of the Crop.—Sometimes the stalks are allowed to stand until the grain is thoroughly ripened, when the huskers go through the fields, row by row, opening the husks, breaking out the grain-bearing cob. More generally the stalks are cut off near the ground either by hand-wielded knife or by special corn harvesters, and the stalks collected and arranged in "shocks" and allowed to stand some time for thorough curing before the husking is done. The husking is done by hand, either from the ears previously broken from the stalk, or while yet on the stalk. At one time it was quite a common custom in many localities, particularly among the young people, to hold so-called "husking-bees." The amount of corn actually husked on such occasions was usually rather negligible, but the fun that was gotten out of the affair was generally "a-plenty." Apples, cider, nuts, pastry were the chief "refreshments," and dancing was often a part of the entertainment. Husking-bees are rarely held in these days, except as friends and neighbors occasionally get together to do for some sick or otherwise disabled person that which he cannot do for himself. On such occasions the social features play only a minor role.

The dried stalks and husks are much used for fodder for cattle (so-called "roughage") sometimes being given in the whole condition, sometimes shredded or cut. Often they are left in the fields over winter and allowed to rot, after which they are "plowed under" in the spring, having some value as a fertilizer. Some of the thin, paper-like, clean inner leaves of the husks were at one time quite a popular filling material for mattresses, for beds, and occasionally some have found use as a substitute for tobacco in the making of cigarettes. And who, among the older people now living who

were brought up on a farm, does not remember the delicate(?) flavor of the corn-silk cigarette as smoked "out behind the barn" where the watchful eye of father or mother could not see?

The Corncob, the portion of the ear to which are attached the kernels and constituting 10 to 14 per cent. of the weight of the husked ear, has a variety of uses. It makes an excellent fuel, having a high heat value, the chief drawback to its use being that it burns so rapidly that fires made with it require such frequent attention. It is sometimes used in place of hickory or other hard woods in the smoking of meats. Real corncob tobacco pipes are well known in some sections, tool handles are sometimes made of corncobs. Chemists in the Department of Agriculture at Washington are said to have worked out a process for the making of furfural from corncobs, the furfural to be used instead of formaldehyde in the manufacture of synthetic resins of the Bakelite, Condensite, Redmanol type. This will conserve the supply of formaldehyde, the methanol from which it is made and the hard woods from which the methanol is made. Furfural is said to be also a possible motor fuel. It has been made from oat hulls and has been selling for about 50 cents a pound, but when made from corncobs the estimated cost will be about 10 ents a pound.

The Kernel.—The corn grain or kernel varies as to size, color, shape and hardness, the variety, the conditions of growth and ripening, the climate and many other factors, each playing a part. By weight it contains, on the average: water, 10.75 per cent.; oil, 4.25 per cent.; protein, 10 per cent.; fiber, 1.75 per cent.; mineral matter, 1.5 per cent.; starch and sugars, 71.75 per cent. It is richer in albuminoids (protein) when ripe than any other cereal, as well as richer in oil; hence flour or meal made from it becomes rancid more readily than flour made from other grains.

Corn Meal was formerly made by grinding corn between stones, bolting to get rid of chaff (bran). Modern milling methods remove the bran and most of the germ (which contains the oil), the resulting product having better keeping properties than the old-time meal. Meal intended for export is being largely made from a degermed grain with the result that much of the prejudice against corn flour has disappeared from European countries where it once existed in a very pronounced form. That was largely why we were

expected to eat more corn in this country during the World War, that wheat could be sent abroad to the people who would not eat corn. Much of what had been shipped them had become rancid on the way over, if it was not already so when shipped. Even in normal times corn meal finds its way into many dishes for the American table. It may not be known to many people today that a hundred years or so ago mush and milk was considered a great delicacy, and hotel and restaurant keepers in Philadelphia advertised in the newspapers that on certain days they would have mush and milk on the bill of fare. Because of the lack of agglutinating power of the nitrogenous constituents of corn flour corn bread and similar products are not usually as light as those made from wheat flour, much of the carbon dioxide gas from the leavening agent escaping before baking has far advanced. Incidentally, for the same reason, pie crust and other baked products made from flour containing corn flour are not as tough and leathery as they often are when made from wheat flour alone.

Much of the corn produced in the United States is not utilized in the making of flour, but is "worked" for the oil and starch it contains. For this purpose the cleaned grain is steeped in water for from three to ten days at a temperature around 140 degree Fahrenheit to soften it, the water being changed frequently to prevent fermentation. Sometimes sulphurous acid is added to the steep water. The steep water, on evaporation, yields a product which, when mixed with other by-products of the industry, serves as a cattle feed.

By means of suitable machinery the softened grain is separated into three parts—the hull, the germ and the endosperm (body). The germs are dried and subjected to pressure in suitable presses to separate much of the oil, the press-cake being afterwards used chiefly in cattle feed. The endosperms are separated into gluten and starch by kneading with water on sieves, the starch and water passing through. The gluten is mixed with the hulls and solubles obtained from the steep water, the mixture dried and sold as gluten feed for cattle. The milky starch liquid is treated with alkali to render soluble any gluten and oil that may be in it, and the starch is afterwards thoroughly washed with water. One bushel (56 pounds) of corn yields about 28 pounds of starch and about one pound of oil.

Corn Oil when properly purified is a neutral bland oil which may be used as a substitute for lard as a cooking oil, and is a good substitute for olive oil as a salad oil. The poorer grades are used in the manufacture of soaps and a rubber substitute suitable for the manufacture of pencil erasers, synthetic shoe soles, and other articles requiring a raw material having similar properties.

Considerable Corn Starch is used in the manufacture of food products, some of it is used as laundry starch, some of it is used in textile industries as the basis of textile dressings, and a great deal of it is converted into dextrine, dextrose and other alteration products.

Dextrine.—In the manufacture of this product several processes are used. In one process the dry starch is heated to about 212 degrees Fahrenheit in revolving drums which are double-jacketed, the space between the inner and outer walls being filled with oil. After the water in the starch is given off there is but little loss; 220 pounds yield about 176 pounds of dextrine. Dextrine made in this way may be quite brown in color. In another process the starch is moistened with dilute acid before heating. The product is nearly white. In still another process 8 to 10 parts of dried malt are added to each 100 parts of starch, the mixture moistened with water at 70 to 80 degrees Fahrenheit and kept at that temperature for about 20 minutes, or until the mixture becomes quite fluid, when the temperature is quickly raised to the boiling point. After cooling and filtering, the dextrine is gotten by concentrating the filtrate. Dextrine is used as an adhesive in many industries, but particularly as the basis of dressings for fabrics and in the manufacture of mucilages and pastes for gumming paper, stamps, etc. Card board of the finer grades is made by gumming and pressing together sheets of paper, dextrine being the adhesive frequently used. Dextrine is also used for thickening colors for calico and other printing sizes, and in leather dressings and pastes.

Dextrose is a sugar largely manufactured in this country by heating corn starch with dilute acid, generally hydrochloric, formerly sulphuric, until a portion of the mixture when treated with Iodine Test Solution fails to give a blue or red color, neutralizing the acid with sodium carbonate (when hydrochloric acid is used) or lime

(when sulphuric acid is used), filtering through boneblack if necessary, and concentrating the filtrate to a thick syrup or solid. When left in the syrupy form the product is usually known as Glucose and consists chiefly of maltose, dextrose and dextrine and some water. This product is used in the manufacture of printers' rollers, candy, shoe polishes and leather dressings, in liquid soaps, in silvering glass for mirrors, in chewing tobacco, in pastes and sizes, for finishing molds in iron foundries, for mixing with cane sugar and cane sugar syrups for table and baking purposes. When concentrated to the solid form it may be used in the manufacture of caramel (sugar-coloring), and for the manufacture of confectionery products. So-called "Corn Syrups" are generally blends of ordinary sugar and commercial glucose syrup, sometimes flavored with vanilla, maple, etc., for special purposes. They do not often contain over 15 per cent. ordinary sugar.

It has been stated that more than a hundred different commercial substances of value in our everyday life may be properly called "Corn Products," but lack of time makes it impracticable to pursue the subject farther at this time.

EFFICIENCY OF SOME COMMON ANTI-FERMENTS.

By Ellery H. Harvey.

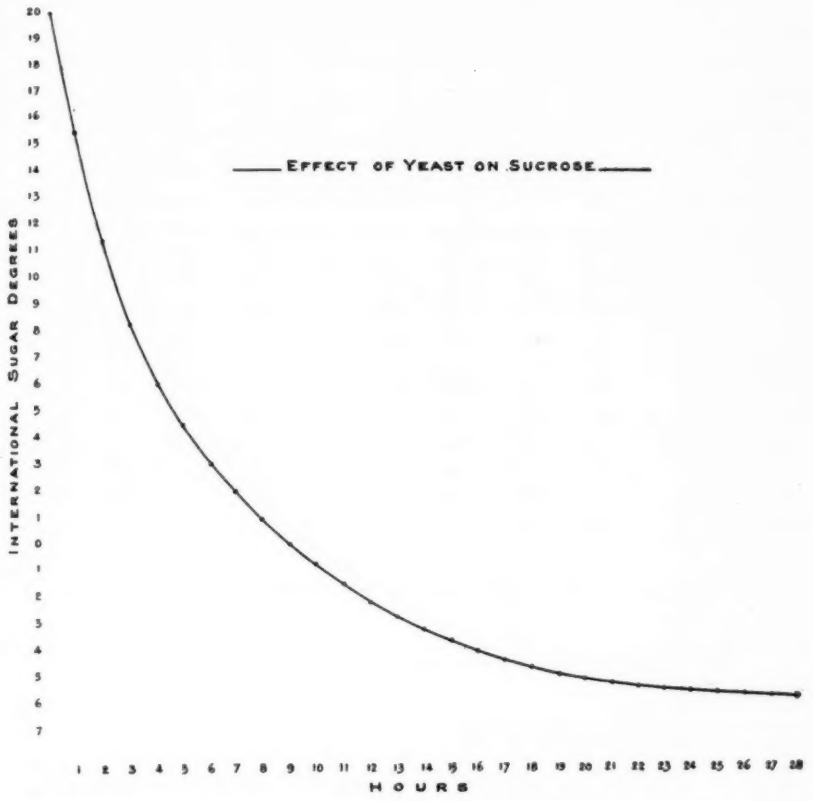
Yeast, due to the enzyme invertase, gradually inverts the disaccharide Sucrose into equal parts of dextrose and levulose. Utilizing polariscopic methods the rapidity of hydrolysis is noted at regular intervals thus obtaining data which on plotting, give a curve that serves as a basis of comparison for the subsequent determinations.

Using the same procedure, given portions of fresh liquid are treated with anti-ferments and the action of the anti-ferment on the yeast is noted by the slowing up of the hydrolysis of the sugar. It follows, therefore, that the greater the change in hourly readings the less efficient is the anti-ferment and vice versa. While not strictly accurate on account of neglecting the possible hydrolyzing action of some of the anti-ferments, the method yields results of reasonable consistency and of sufficient comparative value to make the results quite interesting.

Twenty-six grams of sugar were dissolved in distilled water sufficient to make 250 cc. To this solution was added 3 grams of compressed yeast, a portion filtered and polarized at once and hourly thereafter. The temperature was kept constant at 23° C. The instrument used was a Fric Saccharimeter equipped with an International Sugar Scale. The readings given are those obtained when using a 100 mm. tube and taking the average of five readings, no single reading varying more than 0.5 degree from any other. The filtered portion was used to wash back the residue left on the filter in order to keep volume and reacting materials as constant as possible.

Table No. 1.

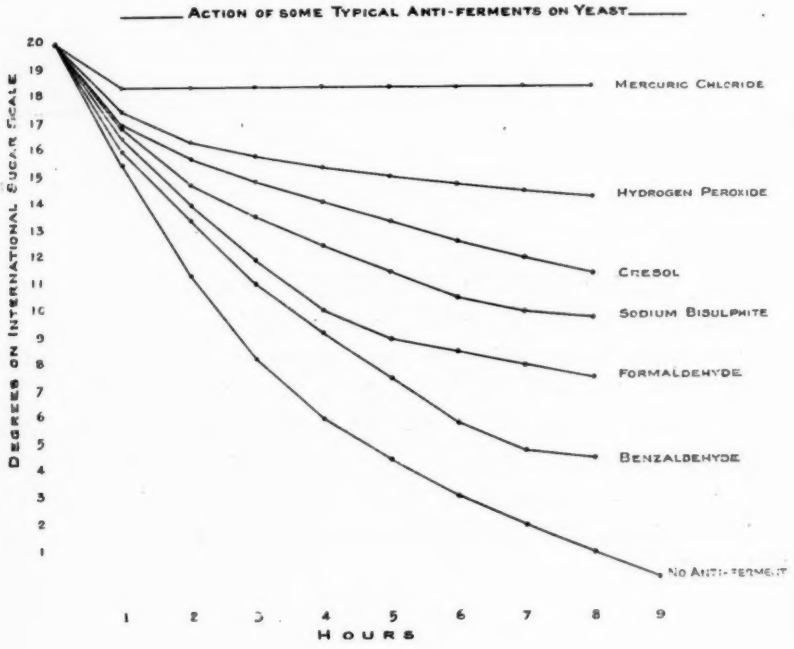
Original			+	20.0	Degrees
End	1st	hour	+	15.5	"
End	2nd	"	+	11.3	"
End	3rd	"	+	8.2	"
End	4th	"	+	6.0	"
End	5th	"	+	4.4	"
End	6th	"	+	3.1	"
End	7th	"	+	1.9	"
End	8th	"	+	0.9	"
End	9th	"		0.0	"
End	10th	"	—	0.7	"
End	11th	"	—	1.4	"
End	12th	"	—	2.2	"
End	13th	"	—	2.7	"
End	14th	"	—	3.2	"
End	15th	"	—	3.6	"
End	16th	"	—	4.1	"
End	17th	"	—	4.4	"
End	18th	"	—	4.7	"
End	19th	"	—	5.0	"
End	20th	"	—	5.2	"
End	21st	"	—	5.3	"
End	22nd	"	—	5.4	"
End	23rd	"	—	5.45	"
End	24th	"	—	5.5	"
End	25th	"	—	5.6	"
End	26th	"	—	5.63	"
End	27th	"	—	5.65	"
End	28th	"	—	5.7	"
End	29th	"	—	5.8	"
End	30th	"	—	5.9	"
End	48th	"	—	6.8	"
End	120th	"	—	6.8	"



For studying the action of anti-ferments on yeast, 114.4 grams of sugar were dissolved in distilled water sufficient to make 1,000 cc. To this solution was added 12 grams of compressed yeast and the liquid divided into 50 cc. portions. To each portion was added 5 cc. of a 1 per cent. solution of the anti-ferment (exception hydrogen peroxide) and the readings taken hourly, conditions and procedure being the same as noted above. The results are noted in Table No. 2, the anti-ferments being listed in the order of their efficiency. Original reading, 20.0.

Table No. 2.

Chemical.	*1st Hour*	*2d Hour*	*3d Hour*	*4th Hour*	*5th Hour*	*6th Hour*	*7th Hour*	*8th Hour*	*Remarks*
Mercuric Chloride	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	C. P.
Pot. Cyanide	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	40% CN.
Sod. Hypochlorite	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	4% Sod. Hypo.
U. V. R. for 20 Min. ..	19.0	18.5	18.0	17.5	17.3	17.0	16.9	16.8	
Sod. Arsenate	17.8	16.4	15.8	15.4	15.1	14.7	14.5	14.3	C. P.
Hydrogen Peroxide ...	17.5	16.3	15.8	15.4	15.1	14.8	14.5	14.2	5cc. 3% U.S.P.
Methyl Salicylate	17.7	16.3	15.1	14.4	13.7	13.3	13.0	13.0	Synthetic.
Salicylic Acid	15.5	14.3	13.2	12.4	11.6	11.6	11.6	11.6	U. S. P.
Cresol	17.0	15.7	14.8	14.1	13.3	12.6	12.0	11.4	U. S. P.
Furfural	15.8	14.0	12.9	11.8	11.0	10.5	10.0	10.0	Technical.
Aluminum Sulphate ...	16.4	14.8	13.6	12.5	11.6	11.0	10.3	10.0	C. P.
Zinc Sulphate	16.1	14.3	13.2	12.1	11.3	10.6	10.0	9.8	C. P.
Sod. Bisulphite	16.8	14.7	13.6	12.4	11.4	10.6	10.0	9.7	Technical.
Formaldehyde	16.5	14.1	11.9	10.1	9.0	8.5	7.9	7.4	40%.
Copper Sulphate	16.0	13.8	12.8	10.6	9.3	8.2	7.5	7.1	Cryst. C. P.
Phenol	16.2	13.6	11.4	9.5	8.2	7.4	6.9	6.9	U. S. P.
Benzoic Acid	15.0	12.5	10.9	9.3	8.0	7.2	6.6	6.2	Synthetic.
Benzaldehyde	16.0	13.4	11.1	9.2	7.4	5.8	4.7	4.4	U. S. P.



The importance of ultra-violet radiations is being increasingly recognized. That they have a pronounced effect on vegetative organisms is indicated below and which further confirms results obtained (unpublished) by the writer on medicinal plants.

Twenty-six grams of sugar were dissolved in distilled water sufficient to make 250 cc. and 3 grams of compressed yeast added. Fifty cubic centimeter portions were exposed to the action of the ultra-violet radiation. The U. V. R. machine was of the disruptive spark type with iron terminals 3/16 of an inch apart; the spark was 6 inches above the surface of liquid, the latter being in constant agitation since any action which takes place in a cloudy liquid is confined largely to the surface.

Table No. 3.

	Exposed 16 Minutes	*Exposed 20 Minutes*
Original	20.0	20.0
1 hour after treatment	18.2	19.0
2 hours " "	16.7	18.5
3 " " "	15.8	18.0
4 " " "	15.3	17.5
5 " " "	14.7	17.3
6 " " "	14.2	17.0
7 " " "	14.2	16.9
8 " " "	14.2	16.8

Conclusions.

1. A method is described for measuring the retarding action of various anti-ferments on yeast-sucrose solutions. The data may be interpreted as a measure of the efficiency of the several materials commonly used for preventing fermentation.

2. While ultra-violet radiation is largely used at present as a bactericide it would seem that for certain purposes its use might be further extended as an anti-ferment, especially since no toxic residue is left in the treated material.

3. It is to be noted that in most cases the action of the anti-ferment is one of gradual retardation rather than immediate cessation of activity.

4. It is rather surprising to note that a number of commonly used materials have a low percentage of efficiency.

5. A later paper will discuss certain other interesting phases growing out of this study.

ABSTRACTED AND REPRINTED ARTICLES

"HIGH-BROW STUFF" AND THE PRESCRIPTION COUNTER.*

By Wilbur L. Scoville.

In recent months articles have appeared in at least three different pharmaceutical journals—and in one of the journals two different articles—on the subject of the hydrogen-ion concentration of solutions.

All of the writers were astute enough to suspect that this subject is of but little if any interest to the average pharmacist, and quasi-apologies therefore accompanied the papers. Also suggestions were advanced as to ways in which this subject might be made to appeal to the attention of the pharmacist. He was told that hydrogen-ion concentration is an important factor in the vitality of living cells, in the constancy of physiological fluids, in the activity of pathological organisms, in the functioning of disinfectants, in the activation of enzymes (including diastase, pepsin, and pancreatin), in the preservation of colloidal conditions, in vitamins (perhaps), in the stability of alkaloidal solutions, in the reactions of sensitive salts, in the fertilizing of soils, in the preservation of serums, and in—well, a lot of things.

But Mr. Pharmacist has preserved his cell vitality, and activated his peptic juices, and disinfected his cuts, and assimilated his vitamins for so many years without even knowing of the existence of hydrogen ions that the concentration of these ions doesn't bother him any. And he sees no use in bothering about them.

Getting Down to Earth.

Thus far nobody has had the temerity to suggest that this high-brow stuff might be dragged down to the prescription counter and made to function on a guileless mixture. Wherein the sapient writers referred to in the opening paragraph missed a point.

Here, then is my opportunity to sit among tne sagacious.

*Reprinted from the *Bulletin of Pharmacy*, October, 1922.

An Iowa druggist recently had the following innocent-appearing prescription presented to him for compounding:

Solution of potassium citrate .....4 fluidounces
Citrated caffeine,
Urotropin,
Potassium acetate, of each .....2 drachms
Peppermint water .....2 fluidounces

Directions: A teaspoonful every three hours.

He made his solution of potassium citrate according to the U. S. P. formula, and in it dissolved the urotropin and potassium acetate. Then he dissolved the citrated caffeine in the peppermint water, added this to the first solution, and got a nice clear solution. Also some good money.

A Mass of Crystals.

A few hours later the bottle was brought back because the mixture was now a mass of crystals and could not be poured out uniformly. The druggist tried a different method of mixing and got the same result, a clear solution at first which later changed to an apparently solid mass of crystals. A third trial made no improvement in final results. Then the physician informed him that his competitor down the street had sent out a clear solution which remained clear, and why couldn't he do the same? Right here is where the concentration started; the "ions" were in the fire.

Now to pull them out.

This is a six-ounce mixture, containing forty-eight fluidrachms and four very soluble salts, namely: potassium citrate, about two and a half drachms, which is soluble in about a drachm and a half of water; potassium acetate, two drachms, which is soluble in about a drachm of water; urotropin two drachms, which is soluble in three drachms of water; and citrated caffeine (really a mixture of equal parts of caffeine and citric acid), two drachms, which, as the Pharmacopœia puts it, is soluble in "a small quantity of water"—let's say an ounce as a good measure.

Here then is about eight and a half drachms of solids which should be soluble, according to all calculations, in thirteen and a half drachms of water, but which refuses to stay in solution in forty-eight drachms! How come?

In the first place, urotropin, also known as hexamethylenamine,

is alkaline in reaction and neutralizes acids. Two drachms of urotropin requires just one drachm of citric acid for complete neutralization, which is just the amount that is present in two drachms of citrated caffeine. We therefore have, theoretically, one drachm of free caffeine, which should be soluble in about 46 drachms of water, and there are nearly 48 drachms of water present.

The expected reaction does not happen, however. For when urotropin is "neutralized" it is gradually decomposed with the liberation of formaldehyde and formation of ammonium citrate. Here's the equation:

$$3(CH_2)_6N_4 + 4H_3C_6H_5O_7 + 18H_2O = 18CH_2O + 4(NH_4)_3C_6H_5O_7$$
(urotropin) (citric acid) (water=(formaldehyde) (ammonium citrate)

But formaldehyde has a very pungent odor, and there is no smell of formaldehyde in the mixture. The citric acid is present and the urotropin is in contact with it, yet they do not react. Wherefore?

Now according to the hydrogen-ion theory the hydrogen-ion concentration is the measure, not of the total quantity of an acid (or alkali) that is present in a solution but of the quantity that is dissociated and thus has free hydrogen ions present which can react with other bodies. For be it remembered, according to Arrhenius, acids and alkalies do not react *as such* but only the dissociated ions of the acid and alkali unite. Hence an acid which dissociates freely is a "strong" acid; it reacts energetically. An acid which does not dissociate freely is a "weak" acid; it reacts sluggishly.

Now citric acid is neither a strong acid nor a particularly weak one in its ionizing qualities. It tends to the weak side but is ordinarily quite active, as all pharmacists know. Yet here it does not appear to act at all.

A Theory Proved.

So again we consider. We now remember that potassium citrate and potassium acetate are excellent "buffer salts." They hinder acids or alkalies, particularly weak ones, from dissociating and therefore from reacting. That is to say, the urotropin has two protectors present—potassium citrate and potassium acetate—which prevent the citric acid from attacking it. So it remains calm and serene in the presence of its would-be destroyer. For the same reason the citric acid is unable to exert its solvent action on the caffeine, and the latter behaves as though it were not present.

These theories are proved by adding two or three drachms more of citric acid to the mixture in compounding. Then a sharp odor of formaldehyde is noted and only a few crystals of caffeine separate out on standing over night. The extra amount of acid partly overcomes the buffer action of the salts, the urotropin is partly decomposed, and most of the caffeine is held in solution.

However, since potassium citrate and potassium acetate are administered in part for their alkaline action on the system, it is not good pharmacy to change the therapeutic action in order to get a clear solution; neither is it good pharmacy to administer formaldehyde when urotropin is wanted.

On substituting hydrochloric acid for the citric in the citrated caffeine we obtain better results. Sixty grains of citric acid is equal to about seventy-eight minims of 34 per cent. hydrochloric acid in total acidity. But hydrochloric acid ionizes more freely in solution and acts as a "stronger" acid. It liberates more hydrogen ions.

By using 60 minims of hydrochloric acid in place of the 60 grains of citric acid in this prescription, the results are apparently the same. The buffer action of the salts is still manifested—probably liberating acetic and citric acids in place of the free hydrochloric acid. If the hydrochloric acid be doubled, the results appear to be slightly better than when citric acid is doubled. And when 240 minims of hydrochloric acid is used in comparison with 240 grains of citric acid, the former solution remains clear at temperatures above about 25° C., while the latter will crystallize. The hydrochloric solution contains about three-quarters as much of total acidity as the citric solution, but since hydrochloric acid is ionized in greater degree its effects are more marked, thus again showing the influence of hydrogen ions in this mixture.

Another proof that the buffer action is the key to the trouble is shown in that if the mixture be compounded as written, then heated on a steam bath for about half an hour, formaldehyde is given off and the mixture remains clear for a longer period. This means that the dissociation of the acid, or in other words the hydrogen-ion concentration, is greatly increased by heat while the buffer action of the salts is reduced. Heating the mixtures containing the extra amounts of citric acid has a similar effect; crystallization is hindered for some time. But in all cases some of the caffeine crystallizes out on long standing, unless a large excess of acid is used, and urotropin is lost if heat or extra acid is employed.

The Best Way Out.

The best way to administer a combination of this kind is to increase the volume of the mixture to the point where the caffeine will remain in solution and not be salted out. In this case make a twelve-ounce mixture in place of a six-ounce by adding six ounces more of peppermint water. Then the dose should be doubled. Also the doctor consulted.

Thus a clear solution would be dispensed with no decomposition of the urotropin and no change in the expected therapeutic effects.

President Lincoln, when a young man, used to say that he wanted to absorb all the knowledge possible. Some of it might not be of any use to him for many years, but it was pretty sure to be of real value some time. Then it would be well worth having.

THE WORLD'S SUPPLY OF IODINE IN RELATION TO THE PREVENTION OF GOITRE.*

Owing to the varying reports as to the concentration of iodine in sea water, I have made a number of determinations on water dipped from the Santa Monica, Cal., pier. Even after filtration, this water contained so much colloidal material as to interfere with the determinations. It was finally observed that thorough shaking with carbon tetrachloride and filtration removed this sufficiently to make analysis possible. The carbon tetrachloride was purified by the addition of a drop of bromine, action of sunlight and shaking with an excess of sodium thiosulfate solution. In determining this excess, some very dilute sodium carbonate solution was poured into the carbon tetrachloride and tenth normal sodium thiosulfate run in, about half a cc. at a time, followed by shaking, until the color disappeared. This solution was separated off and more carbonate and about two cc. of thiosulfate added with thoroughly shaking, followed by separation of the water phase. The carbon tetrachloride was then dried and distilled, the first distillate being rejected.

It was found that evaporation of the sea water until sodium chloride began to crystallize out made it acid, due to precipitation of calcium carbonate and the hydrolysis of $MgCl_2$, magnesium being a

*From the Southern Branch, University of California, and the University of Minnesota. (Reprinted from *Science*.)

weak base, but there was no loss of iodine. Furthermore, a dry salt could be made of the sea water, without appreciable loss of iodine. This was accomplished by evaporation until the calcium carbonate precipitated; precipitation of the remaining calcium and magnesium by the addition of 100 cc. of seven per cent. Na_2CO_3 solution for each liter of original volume; filtration; washing the precipitate on the filter and evaporation of the filtrates to dryness.

In the analysis of the iodine content of salt, it was dissolved in water and the same procedure followed as with brine. In analyzing water or brine, standard solutions of the same NaCl content but varying concentration of iodate were made up and treated in the same way as the unknown. The quantity of reagents added varied with the samples, and no portions were thrown away until the yield of iodine was found to be complete. Each sample if not near neutrality, was neutralized, using test paper, and about 10 cc. of concentrated HCl per liter added. In case buffers were present, at least enough acid was added to react acid to brom-phenol-blue (or methyl-orange). An excess of arsenious acid was added to reduce the iodate to iodide, the equivalent of 1 to 10 cc. of tenth normal per liter, and allowed to stand 20 minutes or more. At this stage colloids, if present, were removed. One per cent. sodium nitrite solution was added to the extent of ten times the quantity of arsenious acid. The sample was then extracted with several portions of carbon tetrachloride which were then collected in a separatory funnel. In cases of 0.04 milligram per 100 cc. of the sample, a pale pink color could be detected in the carbon tetrachloride. The smallest workable quantity, often 1 cc. of very dilute (less than 0.1 per cent.) sulfurous acid was shaken with the extract until complete extraction of the iodine was effected. The carbon tetrachloride was removed from the sulfurous acid solution and a drop of concentrated sulfuric acid added, followed by sufficient sodium nitrite solution to oxidize the sulfurous acid and completely oxidize the iodide to iodine. The iodine was extracted with a sufficient quantity of carbon tetrachloride to fill the colorimetric apparatus (which varied in nature with the size of the yield) and compared with the standards. There must be nearly the same quantity of iodine in the final standard taken for comparison as in the unknown, and the treatment must be identical, quantitatively, especially in regard to volume relations and thoroughness of shaking.

The quantity of iodine found in the sea water was 0.05 milli-

grams per liter, which is a confirmation of the findings of Winkler for Adriatic sea water. Winkler probably had less decaying organic matter in his samples than were present in mine, as he makes no mention of difficulty on account of the presence of colloid material.

A sample of water which I dipped up from the Saltair pier, in the Great Salt Lake, Utah, contained only 40 per cent. more iodine than in sea water although the chlorine concentration was about 500 per cent. greater than in sea water. Since the Great Salt Lake is the residue left from the evaporation of Lake Bonneville, which was 1,000 feet deeper than the Great Salt Lake, and received practically all of the drainage of the Great Basin, covering Utah and parts of neighboring states, we have here a demonstration of the small quantities of iodine that are given up in the weathering of both igneous and sedimentary rocks.

Practically all of the iodine of the earth's surface is in the sea, which contains about sixty billion metric tons of iodine in the form of inorganic salts. This iodine probably entered the sea at the time chlorine accumulated in it. Iodides were probably the most soluble salts on the earth's surface, chlorides being next in solubility. If the earth was once hot on the surface, it is probable that hydriodic acid existed in the atmosphere and was washed into the sea with the first rain. Insoluble iodides of heavy metals are considered by Emmons to be secondary formations, due to the seepage of sea water through ores.

Judging by the prevalence of goitre, there is often a deficiency of iodine in our food and drink. At present, so little is known about the exact quantities of iodine taken into our stomachs that we can judge only by the number of cases of goitre. Omitting the details of local distribution of goitre, there is a wide goitre belt extending north along the Appalachian mountains to Vermont, thence west through the Great Lakes region to Montana and Washington and turning south it finally includes all of the Rocky Mountain and Pacific states. In fact, the goiterous belt includes the mountainous and glaciated regions. Since the run-off from mountainous and glaciated regions has carried away so much of the soluble material, it seems likely for this reason in addition to other evidence that the goiter belt is a low iodide belt.

Since the goiter belt includes large cities and millions of population, it seems unlikely at present that all of its inhabitants will receive

iodide medication in pure form. Since the sea contains the bulk of the supply, the transfer of iodine from the sea to our food or drink should be increased. Perhaps the most attractive method is the inclusion of sea-foods in our diet, but this is limited. Dr. Turrentine, of the Kelp-Potash Plant at Summerland, Cal., informs me that powdered kelp, when added in small amount to food cannot be tasted and when added in larger amount imparts a pleasing taste to it. Since it is richer in iodine than ordinary sea-food and is relatively abundant, it should be an important source of iodine in our diet. Since sea water and salt deposits contain iodine, salt might be made an important source of iodine in our dietary scheme. Blood and shell fish are about the only foods that do not require the addition of salt to make them palatable and fill our physiological needs, and hence the presence of iodine in salt would insure its universal consumption. Mr. O. S. Rask and myself failed to find iodine in any one of a number of samples of salt examined. Salt could easily be prepared from sea water as described above with the retention of the iodine compounds and at a cost not exceeding that of present-day table salt. Some of the magnesium carbonate precipitated from it could be added later if it be desired to make a shaker-salt, but from a nutritive standpoint, the addition of calcium phosphate for this purpose is highly desirable.

J. F. McCLENDON.

University of Minnesota.

LAC MAGNESIÆ.*

By C. E. Corfield, B. Sc. (Lond.), F. I. C., Pharmaceutical Chemist.

The preparation of magnesium hydroxide mixture has for a considerable time been a source of trouble to the practising pharmacist. Published methods by which this mixture is obtained produce preparations which are quite unsatisfactory, because they are not of the consistency of a cream or emulsion. Such preparations under normal conditions show an appreciable separation of water. This question has been raised in connection with the revision of the British Pharmaceutical Codex, and in view of the success resulting from a systematic examination of the problem, it was thought desirable in the

*From the *Pharm. Jour. and Pharm.*

interests of British pharmacy to publish the main features of the work and the method of obtaining a satisfactory mixture.

By the method of the B. P. C. (1911, p. 1287), the mixture is prepared by precipitating and washing magnesium hydroxide, incorporating with this precipitate one-third of its weight of hydrate in the form of light magnesium oxide and mixing with water to give a product containing the equivalent of about 24 grains of magnesium hydrate ($Mg(OH)_2$) per fluid ounce. The addition of magnesia was made probably to give the mixture a less translucent appearance than that associated with mixtures prepared entirely with precipitated hydrate. Nevertheless the product is too translucent and deposits readily. The experiences of other investigators show that alternative methods as published give results equally unsatisfactory. Moreover, a stronger mixture is usually required, and the aim of this investigation has been to produce a mixture containing the equivalent of about 36 grains of magnesium hydrate per fluid ounce.

Magnesium hydroxide, or hydrated oxide, $Mg(OH)_2$, is prepared by mixing solutions of a soluble magnesium salt, such as magnesium sulphate, and a soluble hydroxide, such as sodium hydroxide. It appears as a gelatinous precipitate which, after washing and drying, forms a white amorphous powder. In the presence of water it forms an alkaline mixture which is not caustic, and it is therefore suitable for internal use.

In the experiments described below the hydroxide used was obtained by the interaction of magnesium sulphate, and sodium hydroxide using a slight excess of magnesium salt. A series of tests showed that by interaction at different dilutions the product was always translucent, and, after washing and adjusting by the addition of water to the required strength, it was of the consistency of a jelly. By triturating this jelly with dry hydrated oxide or light magnesia it was shown that a fluid mixture containing the equivalent of 36 grains per fluid ounce could be obtained, and that one part by weight of precipitated hydroxide was capable of suspending one and a half times its weight of added substance. Although such mixtures deposit very slowly, they are less opaque than is desirable. Further experiment showed that precipitated hydroxide was capable of suspending a much larger proportion if incorporated with the sodium hydroxide solution before interaction with the solution of magnesium sulphate. The best results were obtained by taking sufficient magnesium sul-

phate and sodium hydroxide to give one part of magnesium hydroxide, dissolving each in separate portions of water, thoroughly triturating the solution of sodium hydroxide with seven parts of magnesium hydroxide added as light magnesia and after dilution with water, adding this to the solution of magnesium sulphate. The operation of rubbing down the light oxide with the caustic alkali facilitates a creamy product due in all probability to partial hydration of the oxide, whilst the small particles of this material remain suspended in the final product as the result of a film of gelatinous hydrate formed in the subsequent reaction with the magnesium sulphate.

Details with regard to quantities of material and method of preparation are as follows:

Crystalline magnesium sulphate	37.5 gms.
Anhydrous sodium hydroxide	12.0 gms.
Light magnesium oxide	42.0 gms.
Water .....a sufficient quantity	
Distilled water .....to 800 cc.	

Dissolve the sodium hydroxide in 100 cc. of water, triturate thoroughly to a smooth cream with the light magnesium oxide and dilute with water to produce 2,000 cc.; pour the suspension in a thin stream into 2,000 cc. of water, containing the dissolved magnesium sulphate and stir constantly during the mixing. Set aside for twenty-four hours, syphon off the clear liquid, transfer the residue to a calico strainer, allow to drain, wash with distilled water until the washings are free from saline taste, and mix the residue with sufficient distilled water to produce the required volume.

Although the consistency of the product leaves but little to be desired, it can be varied without alteration of strength by an adjustment of the amount of light magnesia used, and a corresponding adjustment of the final volume. Every six gms. of oxide is equivalent to 100 cc. of mixture containing 36 grains of $Mg(OH)_2$ per fluid ounce. Consequently a thicker product can be obtained by incorporating 36 gms. of oxide and making the final volume up to 700 cc., whilst for a more mobile preparation 48 gms. of oxide can be added, and the final volume made up to 900 cc.

The author makes no claim that this is the only method by which a satisfactory magnesium hydroxide mixture can be prepared, and invites suggestions based upon experience that may add to the improvement of the process.

SOLID EXTRACTS

Germany now wants its African Colonies back and in exchange offers the chemical child of a chunk of coal. Bayer's 205 is the synthetic, heralded as a cure for the dreaded African sleeping sickness, the curse of the fertile Congo territory. This new discovery (it is alleged) will open the door of the richest part of Africa to the enterprising colonist by eradicating the disease that has heretofore made colonizing an impossible task.

The Brontosaurus, the largest of all the prehistoric lizards, grew to be sixty feet long and fourteen feet high.

Pasteur, the great French bacteriologist, whose centennial is to be celebrated in December, spent five years studying the diseases of the silkworm for the Department of Agriculture of France.

Sulphur fumes can be used in bleaching cherries, gelatine, fruits, syrups, nuts, potatoes and cereals, by a patent process in which hydrogen peroxide is added to remove all traces of sulphur dioxide which would otherwise be left in the food.

Rhazes, Persian physician of the tenth century, picked out the site for a hospital in Bagdad by hanging pieces of meat in different parts of the city in order to find the place least favorable to putrefaction.

Magnificent orchids and rhododendrons and gigantic blueberries can be grown in ordinary soil to which aluminum sulphate is added, Dr. Frederick V. Coville, chief botanist of the U. S. Department of Agriculture, has discovered. Such rare plants will not flourish in untreated soil that is alkaline.

A grain of musk will scent a room for several years, yet not lose one-millionth of its mass in a year. This is true of the synthetic as well as the natural product.

It may soon be possible to spray your throat and so become immune to pneumonia infection. Dr. Russell L. Cecil and Gustav I. Steffen, of the Hygienic Laboratory of the U. S. Public Health Service, working at Bellevue Hospital in New York have completed experiments on monkeys that suggest that considerable immunity against virulent pneumonia can be obtained by the mere spraying of the throat with a very strong suspension of killed pneumonia germs.

In 1920 pneumonia was responsible for 137.3 deaths out of every 100,000 people in the United States, and in fatality it was outranked only by tuberculosis and organic heart disease. In 1918, when influenza deaths mounted to the high total of 300.8 per 100,000, pneumonia as a frequent after effect caused a pneumonia death rate in that year of 286.2.

Dr. Simon Flexner, of the Rockefeller Institute for Medical Research, has discovered that the clear contents of cold sores on lips and nose of sufferers from encephalitis (American sleeping sickness) will not only produce similar eruptions when inoculated in rabbits, but that a proportion of such inoculated rabbits develop the nervous effects and symptoms of the disease.

Rocky Mountain spotted fever, a highly fatal malady, is transmitted to human beings through the bite of a wood tick infesting the woods and pastures in parts of Montana, Wyoming and Idaho. The disease reaches in certain places and at certain times a mortality of 70 to 80 per cent. Farmers, herdsmen, lumbermen and sportsmen are thus especially attacked.

A serum for combating this highly fatal malady, has been produced in the laboratories of the Rockefeller Institute for Medical Research.

Pneumonia, due to the pneumococcus, alone or allied with the Friedlander bacillus is now classed into three specific types with a fourth group to care for the non-specific cases. A valuable serum has been devised for the treatment of sufferers with the Type 1 infection. Serums for the treatment of the other types are not successful, although the newest plan is to use a solution of polyvalent pneumococcic antibodies separated by chemicals from the organisms and injected into the veins of the patient. This is still an experiment.

SCIENTIFIC AND TECHNICAL ABSTRACTS

PYRAMIDON TEST FOR BLOOD.—Fortwaengler (*British Medical Journal Epitome*, I, 1922, 92) confirms the discovery of Thévenon and Rolland that pyramidon is a much more delicate test for blood than either guaiacum or benzidine. The solutions required for the test are: (1) Pyramidon 5, alcohol (90 per cent.) 100. (2) Glacial acetic acid 25, distilled water to 50. (3) Hydrogen peroxide (Merck) 3 per cent. The original method was as follows: To 2 to 3 cc. of the fluid to be examined were added 6 to 8 drops of the acetic acid solution, 2 cc. of pyramidon solution, and 6 to 8 drops of 3 per cent. hydrogen peroxide. The mixture was well shaken and allowed to stand. The appearance of a lilac color is positive for blood. Fortwaengler has increased the acetic acid solution to 16 drops and the peroxide solution to 12 drops, and claims that this gives a more rapid

and distinct coloration. He also recommends that after shaking up the suspected fluid with the acetic acid solution and allowing the mixture to stand for a time, the test tube should be inclined and the hydrogen peroxide solution gently poured on the surface of the mixture; if blood be present a "lilac cloud" will appear very suddenly; if this is absent at the end of two minutes the specimen contains no blood.

Fire-Retarding Chemical for Wood.—Factors influencing choice of such a chemical are: Salt must not attract water too much or the wood will always be damp. It must not affect tools of workman and also any metal fittings applied to the wood. It should not be poisonous in case a splinter should enter a person's hand. It should be fairly effective at low concentrations. It should not be volatile at ordinary temperatures nor soluble if used for outside work. It should penetrate easily. It should not affect the strength of the wood nor affect any decorative coating applied over the wood. Thus, it seems that the search for practical retardent chemical is beset with great difficulties, for those salts that are readily obtainable fail in one or more of these seven conditions. Chemicals tested fall into three classes. The fire promoters are cupric chloride, bismuth chloride, ferric chloride, alum, barium sulfate and stannic chloride. Those that have little effect on the wood are ammonium chloride, sodium chloride, boracic acid, and aluminum sulfate. Those that have a fire-retarding effect are zinc chloride, mixture of phosphate and borax, magnesium chloride, calcium chloride, ammonium sulfate, ammonium phosphate, borax, sodium silicate, and zinc ammonium phosphate. Ammonium phosphate was best of all tested, since it gives off an incombustible gas, ammonia, leaving orthophosphoric acid that melts and covers fibers of wood.—(W. O. Banfield and W. S. Peck, *Canadian Chem. and Met.*, 8-22, 3000 w. CJW.) Through *Industrial Digest.*

Muscarine, Isolation of ——, the Potent Principle of Amanita Muscaria.—About 0.12 g. of pure muscarine aurichloride was isolated from 25.5 kg. of fresh *A. muscaria* after a long and tedious process which consisted essentially of several precipitations of the clarified alcoholic extract first with aqueous, and then with alco-

holic mercuric chloride, and finally with phosphotungstic acid. The precipitated bases consisted chiefly of choline and muscarine in the proportion of about 20 to 1, and the former was largely removed by fractionation of the *d*-hydrogen tartrates. Fractionation was continued by means of the aurichlorides, and finally large delicate leaflets of pure muscarine aurichloride were isolated. The whole operation was controlled physiologically by following the distribution of activity by observations of the effects produced on an isolated loop of rabbit's intestine. Pure muscarine chloride was found to be about seven times as active as arecoline, and five times as active as acetylcholine. Physiological assay assigns a content of 0.4 g. of muscarine chloride to the extract from 25.5 kg. of fresh fungus. Muscarine chloride has a molecular weight of about 210; it is quite stable towards alkali and cannot therefore be an ester of choline, nor is there any evidence for the accepted formula with one oxygen atom more than choline, or that it is a quaternary base. It appears to be an alkaloidal base of considerable complexity.—G. F. M. (H. King. *Chem. Soc. Trans.*, 1922, 121, 1743-1753.) Through *Journ. of Chem. Ind.*

Classification of the More Important Industrial Catalytic Reactions

Type of Catalyst	*Samples of Exemplification in Industrial Practice*
	Hydration and Hydrolysis
Acids	(a) Hydrolysis of glycerides, soap and candle industry, sulphuric, sulphonic (Twitchell reagent) acids as catalysts.
	(b) Hydrolysis of starches and wood cellulose to yield sugars. Sulphuric, hydrochloric, sulphurous acids as catalysts.
	(c) Hydrolysis of esters using acids.
	(d) Hydration of acetylene to yield acetaldehyde. Various acids as catalysts.
Alkalies	(a) Hydrolysis as in (a) and (c) above. NaOH, KOH, $Ca(OH)_2$, MgO, ZnO as catalysts.
	Dehydration
Acids	(a) Manufacture of ether. Sulphuric, sulphonic and phosphoric acids as catalysts.
	(b) Esterification processes. Hydrochloric and sulphuric acids as catalysts.
Oxides	(a) Manufacture of ethylene and unsaturated hydrocarbons. Clays, Al_2O_3, SiO_2, TiO_2 as catalysts.
	Halogenation
Non-metallic elements	(a) Chlorination of carbon disulphide, carbon-monoxide and hydrocarbons. Carbons, iodine, sulphur as contact agents.
Chlorides	(a) In synthetic organic, chemistry. $AlCl_3$, $FeCl_3$, $SbCl_5$, $SnCl_4$, $ZnCl_2$, $HgCl_2$, as contact agents.
	Oxidation
Metals, especially the platinum metals	(a) Contact sulphuric acid process using finely divided platinum on a suitable support.
	(b) The oxidation of ammonia using a platinum gauze.
	(c) The preparation of formaldehyde, using copper or silver (see dehydrogenation).
Oxides	(a) Lead chamber process, employing a gaseous catalyst, oxides of nitrogen.
	(b) Contact sulphuric acid manufacture with iron oxide catalyst.
	(c) Chance-Clause process of sulphur recovery. Oxide of iron as catalyst.
	(d) Purification of illuminating gas. Hydrated oxide of iron as catalyst.
	(e) Surface combustion processes, refractory oxides as catalysts.
	(f) Oxidation of hydrocarbons, V_2O_5, MoO_3, WO_3, etc., as catalysts.
Salts	(a) Deacon chlorine process, copper chloride as catalysts.
	(b) Oxidation processes in the dye industry. Mercury and copper salts.
	(c) Oxidation of aldehydes, manganese salts as catalysts.
	(d) Drying of oils. Metallic soaps as accelerators.
	Hydrogenation
Metals	(a) Hydrogenation of oils. Nickel and platinum as contact agents.
	(b) Fine organic chemical industry, e. g., synthesis of cyclo-hexane, reduction of organic compounds. Nickel as catalyst.
Oxides	(a) Hydrogenation of oils, nickel oxide as catalyst (especially at elevated pressures).
	Dehydrogenation
Metals	(a) Cracking of oils, nickel, copper, iron, aluminum as catalysts.
	(b) Dehydrogenation of alcohols, copper, silver and nickel as catalysts.
Oxides	(a) Cracking of oils, Al_2O_3, and TiO_2 as catalysts.
	(b) Dehydrogenation of alcohols, ZnO, SnO, CaO and MgO as catalysts.
	Nitrogen Fixation
Metals and metal-oxide mixtures	(a) Ammonia synthesis. Reduced iron, iron-molybdenum, iron-potash, and nickel-sodium as contact agents.
	(b) Cyanide formation. Reduced iron as catalyst.
	(c) Arc process of oxide of nitrogen formation. Metal electrodes as negative catalysts.
	(d) Nitride formation (Serpek process). Iron, copper, chromium, molybdenum, etc., as catalysts.

Chemical Age.

REVIEW OF CURRENT FRENCH LITERATURE.

By William H. Gano.

Preparation of Samples for Analysis.—Sufficient importance is not accorded this operation; it is as important, nearly, as the analysis itself. The writer is opposed to the use of sieves—one separates in this way parts having different physical properties, and their ultimate normal mixture is problematical—the prolonged and repeated return-sievings do not suffice in certain cases. Mixing in a mortar is not always efficacious. The reduction of a bulky sample to one of less volume is delicate, and can only be correctly done by the repeated division of the material put into a square and divided by diagonals—taking each time the opposite triangles. It is necessary to distrust mixing machines—certain of them, by their principles of constructon, separate materials in the order of density.—From *Chem. Ztg.*, through *Annales de Chemie Analytique.*

Formation of Precipitates From Friction of Glass.—When one rubs the sides of a glass vessel with an agitator fine particles of glass can always be obtained, which have an influence in the determination of a crystallization or a coagulation. By prolonged friction one can always produce a precipitate—even in distilled water—and beginners must be on their guard.—From *Zeits. Electrochem* through *Annales de Chemie Analytique.*

On the Inflammability of Benzin, etc.—The spontaneous ignition of *anhydrous* and inflammable liquids often takes place during the decanting, or filtering of these liquids in a glass funnel, whatever may be the nature of the receptacle from which the liquid is poured—though from glass to glass is the more dangerous.

I have noticed, in a dull light, sparks under these circumstances—but insufficient to produce flame. For a long time I have forbidden the use of glass receptacles or glass funnels in the manipulation of these liquids.—A. Brun in *Journal Suisse de Pharmacie.*

Creasote in Dental Treatment.—The analgesic and mildly caustic properties of creasote cause it to be chosen in the treatment of pulps and dental neuralgias. The reputation laid to creasote of causing the teeth to break or crack is absurd. The decayed tooth breaks, not because it has been in contact with creasote, but simply because it

has been neglected in regard to filling. Coal-tar creasote, being more caustic, calms quicker than that from Beechwood—but the latter should be always used in dental treatment.

Creasote can be used pure or mixed with other remedies in the treatment of dental fistulas, pulps, or after extraction. An excellent formula is the following:

Beechwood Creasote	4 gm.
Alcohol (95%)	2
Guaiacol	2
Formol (40%)	1.50
Ess. of Rose Geranium	0.50

This formula has the advantage of slightly masking the odor of the creasote.—From *Journal des Pratciens,* through *Bull. des Sci. Pharmacologiques.*

Increase of Specific Activity of Metals by Addition of Lipoids.—In the matter of tin, mercury, or the salts of didymium the addition of lipoids presents four advantages in the opinion of Dr. Mollin in *Journal de Médecine et Chirurgie Pratique:*

First. It enables us to obtain, in infinitesimal doses, results equal or superior to those obtained from the natural metal given in the usual doses.

Second. The extreme dilution of the metal excludes all possibilities of intolerance; it seems that with equal quantities the metal in lipoidal association is less toxic than when natural.

Third. This extreme dilution has moreover the advantage of permitting hypodermic use.

Fourth. Administered intravenously, the lipoidal metal provokes no phenomenon of shock.—From *Répertoire de Pharmacie.*

Casein Cement.—After many trials undertaken by the English Bureau of Aeronautics the following formula for cement has been approved as best for retaining its adhesive properties:

Casein	78.
Sodium Carbonate (dried)	4.5
Sodium Fluoride	4.
Quick-lime (freshly slaked)	12.5
Sodium Arsenate	1.

Mix all together and pass through a sieve of twenty meshes. The preparation is used either with water or a weak solution of gelatin.—*Pharmaceutical Journal.*

Care Required in Handling Chrysophanic Acid.—The following note has lately appeared in *Le Bulletin de la Société de Pharmacie de Bordeaux.*—A pharmacist in preparing an ointment of vaseline and Chrysophanic Acid received some dust from this acid in his eyes. In about two hours itching ensued, followed by severe pain and intense conjunctivitis, with confused vision caused by clouding of the cornea. Relief was obtained from fomentations of infusion of elder blossoms with sodium biborate and laudanum added. For two weeks intense suppuration occurred. After eighteen days the vision improved somewhat, but at the end of six weeks had not recovered its former acuity and reading was very difficult.—From *Répertoire de Pharmacie.*

Elimination Through the Urine of Small Doses of Sodium Salicylate.—In his own name and in the names of MM. Fiessinger and Debray, M. Herissy has communicated to La Société de Pharmacie de Paris the results of researches which they have undertaken to determine the smallest possible quantity of Sodium Salicylate which a man can ingest in order to detect this substance in the urine. In following out their experiments they have detected this salt in the urine of persons who have only swallowed two milligrammes.—From *Répertoire de Pharmacie.*

Radioactive Elements as Indicators in Chemical Research.—Certain radioactive elements which are isotopic with a stable element can be employed with advantage as indicators. They can, when mingled, augment considerably the possibility of determining the element in question. In practical chemical analysis the radioactive elements prove of great utility in determining the solubility of salts difficultly soluble (lead chromate, for example) and for explaining or studying certain phenomena in the reactions of precipitation.—from *Chem. Ztg.,* through *Annales de Chemie Analytique.*

Butyl-ethyl-malonylurea—a New Hypnotic.—M. Tiffenau has presented to La Société de Pharmacie de Paris some researches made by him, concerning several hypnotics of the barbituric acid series, pointing out the above as being more active and acting more rapidly

than veronal. With man, the medicament in question acts as a hypnotic and as a sedative to the nervous system, the activity being about three times greater than veronal.—Abstract from *Répertoire de Pharmacie.*

Myrrh, Olibanum and Gum Arabic.—According to an American Consular report, the three principal gums produced in the basin of the Red Sea are, in the order of their importance, Myrrh, coming from Abyssinia and the interior of Arabia; Gum Arabic from Somaliland and Mokalla; and Olibanum, from British Somaliland, the Yemen and the Isle of Socotra. The Abyssinian Myrrh is considered the best. With the exception of the gums from the interior of Arabia, nearly all the collectors are Somalis, who carry their merchandise in a crude state to Aden, where it is sold to the merchants, who sort and prepare it for exportation.

Ellagic Acid in Raspberries.—M. Kunz-Krause (*Archiv der Pharmacie*) has observed in some syrup of raspberries prepared with the greatest care, a short time after its preparation, the production of a precipitate formed of small, brilliant, prismatic crystals, impregnated with a red coloring matter—insoluble in water and the ordinary solvents. Those crystals have been identified as ellagic acid.—From *Répertoire de Pharmacie.*

Pharmaceutical Antiquities.—L'institut de Pharmacie de Université de Lausanne has acquired the Reber collection of pharmaceutical antiquities. This collection will be placed and inaugurated next year on the occasion of the fiftieth anniversary of the founding of the university.—*Journal Suisse de Pharmacie.*

MEDICAL AND PHARMACEUTICAL NOTES

BUREAU OF CHEMISTRY TO ELIMINATE ADULTERATED MARJORAM FROM INTERSTATE AND FOREIGN COMMERCE.—Steps to eliminate excessive foreign and objectionable leaves from marjoram are being taken by officials of the Bureau of Chemistry, United States Department of Agriculture, which is charged with the enforcement of the Federal Food and Drugs Act.

A recent investigation by the Bureau of Chemistry shows that marjoram from foreign sources frequently contains Cistus leaves. The presence of any appreciable amounts of Cistus or other leaves constitutes an adulteration of marjoram when shipped within the jurisdiction of the Federal Food and Drugs Act. In some instances marjoram was found to contain 25 per cent. or more of Cistus leaves.

The presence of Cistus leaves may be recognized by the blackish brown color which is developed when these leaves are soaked in concentrated ammonia. Coriaria, previously found present, and Althea under these conditions give a light brown color while marjoram remains light green.

Caution on the part of the importer would assist in discouraging and eliminating this form of adulteration. The dealer who ships adulterated marjoram into interstate commerce is responsible under the Federal Food and Drugs Act and should take steps, officials say, to correct this condition in order to free himself from liability to prosecution. Inspectors have been directed to give special attention to shipments of marjoram. Appropriate action under the Federal Food and Drugs Act will be taken in all cases found to be in violation of the law.

CARBON TETRA-CHLORIDE AS AN ANTHELMINTIC.—A review of the work done by various men is presented by G. C. Lake (*U. S. Public Health Reports,* May 12, 1922) as well as an extended report of his experiments which were carried on with several monkeys as the subjects. Experiments carried on by M. C. Hall (*Jour. A. M. A.,* 77, 21) indicate that the drug is not toxic to dogs when given in as large a dose as 1.5 cc. per kilo body weight. He found that 0.3 cc. per kilo of body weight was the effective dose and considered that carbon tetra-chloride was the most effective drug therapeutically and the least toxic of any of the vermifuges not excluding thymol and chenopodium.

It being apparent that repeated doses might be advisable, Lake took a number of monkeys as subjects and administered definite quantities of the drug to them over a period of one month. Doses varied in quantity from 1 cc. for monkey number one to 5 cc. for monkey number five. No apparent ill effects of the drug were noticed in any

of the subjects nor was intoxication evident. The drug was administered by stomach tube on an empty stomach.

As an anthelmintic for man a dose of 3 cc. is suggested to be given in hard gelatin capsules on an empty stomach. No cathartic should be given either before or after administering the drug as the carbon tetra-chloride induces active peristalsis. Breaking of the capsules in the mouth should be avoided as the entrance of the drug into the trachea might cause serious results.—J. W. E. H.

USE OF QUININE INTRAVENOUSLY IN THE TREATMENT OF MALARIA.—Kenneth F. Maxey cautions against the unrestricted use of Quinine intravenously in the treatment of any form of malaria. Particular note is taken of the danger accompanying the administration of solutions of the usual concentration of 7½ grains of the double salt of quinine and urea hydrochloride per cc. When 2 cc. of the above solution is introduced intravenously employing the usual hospital or private practice technique a marked quickening of the pulse is noted as well as a fall in both the systolic and diastolic pressures. Distressing nervous symptoms were also produced as well as sloughing of the tissues when small amounts of the solution were injected into the tissues accidentally.

Intravenous injection of quinine rapidly destroyed the asexual form of the parasites, however, the same results are obtained by oral administration, though somewhat longer time is needed. Whether quinine has any effect on the sexual form is still questioned no matter how it is introduced into the system.

Intravenous injection should only be resorted to when it is impossible to give the drug orally or where immediate cinchonization is indicated. In such cases the drug should be given well diluted, preferably ½ grain of the di-hydrochloride per cc. and in doses of 15 grains. The solution should be introduced under strict asepsis and injected into the blood stream slowly.—*U. S. Public Health Reports,* May 12, 1922.) J. W. E. H.

NEWS ITEMS AND PERSONAL NOTES

AMERICAN PHARMACEUTICAL ASSOCIATION, COMMITTEE ON RESEARCH, AWARD OF 1922-1923 RESEARCH GRANTS.—At the Cleveland meeting of the American Pharmaceutical Association the following grants were made from the A. Ph. A. Research Fund.

To D. I. Macht, Baltimore, Md., for pharmacological work on benzyl compounds	$200.00
To Albert Schneider, Portland, Oregon, for chemical and pharmacological work on Chaparro Amargosa and on Sodium Cinnamate	200.00

BOOK REVIEWS

ECLECTIC MATERIA MEDICA, PHARMACOLOGY AND THERAPEUTICS. By Harvey Wickes Felter, M.D., Professor of Materia Medica in the Eclectic Medical College, Editor *Eclectic Medical Journal*. Royal Octavo, 743 pp. illustrated. Cloth, $8.00. John K. Scudder, Publisher, 630 W. Sixth Street, Cincinnati, Ohio.

This is an unique volume, described by its author as an answer to the request of his pupils for a collection of his readings. So that an insight may be had to the expansiveness of the fields treated in the book, the table of contents is printed herewith.

Part I.

INTRODUCTION.

Chapter

I. Definitions and General Considerations.
A Medicine, A Drug, Materia Medica, Pharmacodynamics, Toxicology, Pharmacology, Physiological Action, Therapeutics, Empirical Therapeutics, Rational Therapeutics, Specific Medication (Specific Therapy), Other Forms of Therapy, Pharmacognosy, Pharmacy, Posology.

II. The Parts, Constituents, and Derivatives of Plant Drugs.
Parts of Plants Employed as Medicines, or in Their Preparation, Derivatives of Plant Drugs, Proximate and Other Principles of Plant Drugs.

III. Pharmaceutical Forms and Classes of Medicines.

IV. Action and Effects of Medicines.
General Nature of Drug Action, Effects of Drug Action, Selective Drug Affinity, Absorbability of Medicines, Administration and Rate of Absorption and Elimination, Circumstances Modifying Drug Effects, Cumulative Action, Drug Tolerance, Idiosyncrasy, Synergists and Antagonists, Dosage, Dosage of Specific Medicines, Salt Action.

V. Application and Administration of Medicines.

VI. Incompatibility.

VII. Management of Acute Poisoning.

VIII. Dispensing of Medicines.

IX. Specific Medication.

X. Classification of Specific Medication.

XI. Prescription Writing.
The Prescription, Medical Latin, Rules and Groups of Terminations, Construction of the Prescription, Illustrative Prescriptions.

XII. Weights and Measures.

XIII. Percentage Solutions and Dispensing Tables.

XIV. Definitions of Therapeutic Terms.

XV. Abbreviations, Words and Phrases.

XVI. Pharmaceutical Preparations With Doses (Other Than Specific Medicines).

XVII. Therapeutic Classification of Drugs.

XVIII. Sources of Drug Knowledge.

Part II.

Individual Drugs.

The new school of medicine that issues a vest-pocket pharmacopœia printed in 24-point Caslon type, will gaze with wonderment and benign sympathy at a publication as comprehensive and ponderous as

the volume reviewed. But this is no ordinary pharmacopœia. It is a marvellous hybrid of the dispensatories, pharmacopœia, textbooks on pharmacognosy, botany, chemistry and a host of other sciences; illustrated profusely and well it adds a pleasant moistness to otherwise arid reading—arid in so far as it dwell over-lengthily and without a rational basis upon the specific indications and therapy of its drug subjects. For instance, to gelsemium it dedicates fully five pages of intimate consideration. For iodine, a far more important drug, two pages are deemed essential. Asepsin a proprietary drug, little-known and less-used, is accorded more space than aspidium. Numerous such instances may be quoted. The author frankly acknowledges these peculiarities in his book, but the book nevertheless suffers from such treatment.

There are omissions of newer remedies which might be termed unfortunate; silver arsphenamine and scarlet red, for instance. Also a number of errors have crept into the text, particularly so in the chemical formulas recorded. On the whole, however, the volume is well arranged, well printed and well bound. It commends itself best, of course, to the eclectic physician and pharmacist, but contains much material, not found elsewhere, of exceeding interest and information to all students of medicine and pharmacy.

I. G.

National Cleaner and Dyer Book of Technical Notes. Revised and arranged by Roy Denney, Editor. 232 pp. Cloth $2. Dovost Bros. Co., Chicago, 1922.

The contents of this book comprises the Technical Notes and Question Box matter, together with other valuable information, compiled from the columns of the *National Cleaner and Dyer,* a monthly trade journal published since 1910. No attempt has been made to arrange and classify the subject matter except under the several general headings. The reader is advised to depend on the index and to consult it freely for locating the subjects and information desired. The information contained in the book will be helpful in solving many of the problems met by cleaners and dyers in the everyday work. The book is also very useful to the retail pharmacist who is consulted daily by his customers on topics of this sort. Editor Denney presents

much valuable information which can be readily turned into dollars and cents. On page 86, for instance, we find the new and excellent suggestion that formic acid is an effective agent for removing most all ink stains and also indelible pencil stains without affecting fast colors and without injurious action on fabrics of silk, wool or cotton. This information alone is worth the price of the book, which, therefore, we can highly recommend to druggists in general.

OTTO RAUBENHEIMER, Ph. M.

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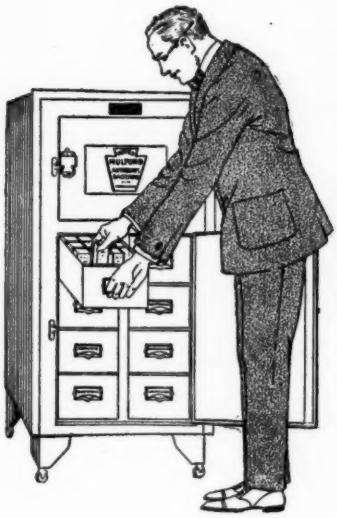

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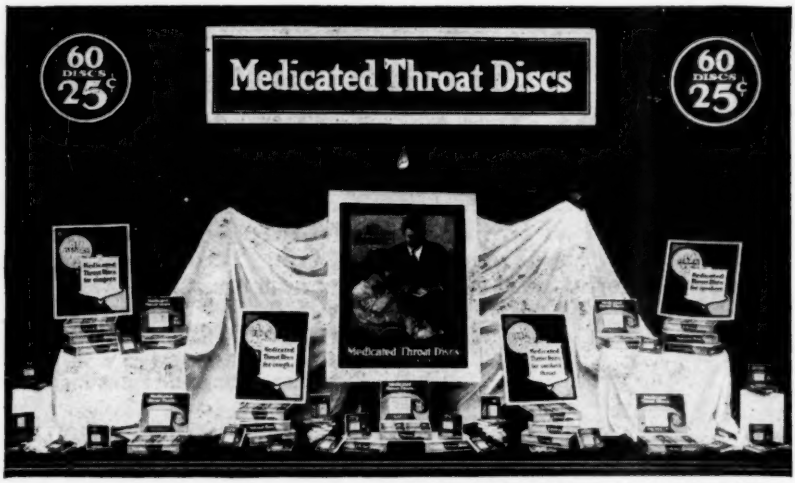

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